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JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION

STATISTICS AND ART[1]

By William F. Ogburn

My predecessors in office have discussed before you in a series of able addresses most of the aspects of statistics that are of interest to a general audience of social scientists. Yet, statistics is one of those words, like democracy or science, the meaning of which never seems exhausted. And so I have thought that by comparing statistics and art, some new light might be thrown on the place of statistics in the theory of knowledge. But if I am presumptuous in these expectations, I am sure such a comparison will be productive at least of an emphasis much needed today.

Statistics has been developed to give an exact picture of reality, while the picture that the artist draws is a distortion of reality. Even the portrait painter does not want to be photographic. The statistician wishes to make the probable error as small as possible; while the artist must always, so to speak, have an error. With some of the cubists, as, for instance, the painter of the famous picture of the so-called nude descending the so-called staircase, the purpose seems to have been to produce an error as large as possible. The artist, being impressionistic, is as little realistic as he can afford to be. But since art is a form of communication varying degrees of realism are demanded from age to age and from situation to situation, for without a sufficiently realistic medium the message is not adequately communicated.

The reason why the artist wants to change reality is that reality is unkind to him. He is uncomfortable in it and comes to have an inner message that is more beautiful to him than reality. The distortion he makes is an improvement of reality. His art is a product of his dream world expressed in terms of beauty.

Art is not, of course, the only sphere conspicuous for its departure from reality. The beliefs of the religious are signal distortions of reality. The belief in life after death is undoubtedly correlated with our

[1] Presidential address at the Ninety-third Annual Meeting of the American Statistical Association, December 29, 1931.

hopes. Heavens are pleasant places in which to live, and the forms our souls take after death are such as we would like to have them take. The man of God finds this vale of tears and abode of sin a hard place to live in. And so the symbols, rituals and divinities in religion all serve to release him from the bonds of the here and now. Thus there is comfort and solace in religion, just as there is harmony in the works of the artist. Underlying both art and religion is the fundamental maladjustment of psychological nature to environment. But the way out is different. For the artist it is beauty; for the man of faith it is belief.

Nor is the distortion of reality confined to the artist and the religious. The insane find a less attractive way out. Daydreamers and idealists find their escape in dreams. The unreal world of fiction, of stories of romance and adventure, are outlets for others of us whose adjustments do not satisfy our wishes. So universal is this habit of distorting reality that it may be said to be human. It is a habit that has to be unlearned by every statistician, the hardest task in his training.

The artist, the religious and the insane take more liberties with reality than other groups such as social reformers and promoters who are held within more reasonable bounds. While, therefore, there are many groups who misrepresent, artists may be singled out for comparison with statisticians because the distortions of artists are more like those which statistics seeks to prevent and to remedy.

This comparison may be approached by relating an incident that occurred once when I was attempting to mediate some labor difficulties in a steel plant. The morning I arrived the difficulties came to a head. I called at once to see the manager, and asked how many men were on strike. He replied that, indeed, there was no strike, that they were all just a happy family, but admitted that 200 men didn't report for work that morning. I then went out to talk with the agent of the union, and he told me excitedly that the plant would be closed completely by afternoon and that there were 15,000 out on strike at that moment. The true number proved to be about 9,000. Their statistics were not very accurate. They were both distorting reality in trying to make their respective worlds more comfortable for them. Here, as is so often the case, exact measurement eliminated errors due to prejudice.

Our language shows how strongly artistic and how little scientific we are. This is particularly true of the words of children, of poets, and of the folk. For instance, goldenrod is neither golden nor is it a rod; but goldenrod is a beautiful name as becomes a beautiful flower, and we like the distortion because of the charm in the associations it calls forth. We much prefer to call *delphinium tricorne* by the name of larkspur than by its scientific name, even if the resemblance of the flower to the spur

of a lark is only slight. It is pleasant to think of so beautiful a songster as a lark having a spur like this lovely flower.

Similarly our adjectives are often colorful and do not lend themselves readily to accuracy. Thus the air is only hot or cold, or perhaps cool or warm. None of these expressions is very accurate, for we want this room 68 degrees warm, no more, no less. So we record refined measurement by expressing the adjective in terms of degrees. The adjectives tall and short have been refined into inches. Many adjectives still are enemies to accuracy, however. For, who would want us to say that the Mona Lisa was only 68 degrees beautiful. But perhaps the judges in a beauty contest for Miss America do have such a beauty thermometer. All inventions have a limited use at the beginning.

The point may be further illustrated by comparing the first five adjectives in Keats' "Ode to a Nightingale" with the first five adjectives from Egon Pearson's article on "The Test of Significance for the Correlation Coefficient" appearing in the JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION. Keats' adjectives are the following: drowsy, dull, happy, light-winged, and melodious; while Pearson's are the following: statistical, alternative, observed, little, and numerical. The number of adjectives per 100 words in Keats' Ode is two and one-half times as large as the number in Pearson's article on correlation. It is interesting also to note that H. G. Wells' *Outline of History* ranked in this regard just half way between Keats' poem and Pearson's article.

While statistics should render an exact account of reality, they do not always succeed in doing so. It is not so much that figures lie, as the old saying goes, as that liars figure. But if statistics were truly successful in preventing distortions, liars could not figure and get away with it. In social theory, in literature, and in philosophy there is no measure of the error, and the distorting effects of wishes are less easy to isolate than in statistics.

Statistics has given much more attention to the error in samples caused by a multitude of small causes, i.e., chance, than it has to the error due to a single large cause, as, for instance, prejudice. The theory of errors is one of the great achievements of science; but now more attention should be given to tests for the representativeness of samples from heterogeneous phenomena. Indeed, such a problem is not now thought of as a matter of statistics, but rather of psychology. For how can statistics prevent liars from figuring? Under the present status of conditions it is better to follow Freud than Gauss. Yet the place of statistics in the scheme of knowledge is as the champion of exactness and, surely, selection and representativeness in samples are of the greatest importance.

The shortcomings of statistics in this regard are most clearly seen in the case of statistical description. The point is well illustrated in a story told about Bernard Shaw and Sidney Webb. In the early days of the Fabians, Webb is said to have read a paper on the growth of municipal ownership, made up largely of statistical statements. Shaw criticized it as a grossly inaccurate presentation. Webb replied hotly with a challenge to show a single error in any statement. Shaw replied that of course all the statements were accurate, but that the whole, which was not the sum of the parts, was quite inaccurate since the municipalities that had not gone in for ownership had been omitted, making the paper give the picture of a stampede toward municipal ownership, which was far from the case. Curiously, the artist proved the better statistician. Description of multiple phenomena, such as a country, a people, or an epoch necessarily involves selection. That is why history must be rewritten in every age. Where the opportunities for selection are many, there we may expect to find the artist, the arch enemy of statistics. It may be argued that the scientist in drawing a generalization is doing what the artist does. It is true that they both select but the purpose of the scientist is to be exact while the purpose of the artist is to change reality.

Selection is at the very basis of our thinking which is largely a process of selecting a few memories and observations from the many possible ones. This sampling from the vast storehouse of our memories is not a very representative process. It is well known that we are prone to select that which is pleasing to remember. And so we recall "the good old days." Our memories of childhood are treacherous misrepresentations, while our national heroes such as the founder of our nation, become changed beyond all recognition. So powerful is this selective force that the face of reality is changed completely sometimes, as when we have hallucinations, which a sizeable percentage of us do have at times; that is, we hear voices when there are none and see mirages when there is nothing but atmosphere. It is this distorting influence of emotion and wishes that is more responsible for bad thinking than any lack of logic.

This selective nature of thought and observation is very well seen in the milder cases of manic-depressive insanity when the individual at one time can see nothing but clouds with no silver lining anywhere in the future, while a little later in their manic phase all will be sunshine with never a fear; views of reality quite unjustified by the facts.

Statistical descriptions are not wholly helpless before the selective tendencies. In most cases the statistical material is so scanty that

one can ill afford to omit. The convention, today, is to survey all available statistical information. On the other hand, confining description only to statistical material itself produces a bias because of the omission of the non-statistical account. Furthermore the task of getting a representative sample from a complex universe is not insuperable. Indeed, the very raising of the question puts one on guard against biased samples. Still the problem of representative samples is of cardinal importance for statistics.

Further comparison of statistics and art reveals another important limitation of statistics. To the artist, statistical knowledge seems woefully inadequate. The artist is interested in imparting and receiving ideas that are rich in feeling tones. They must carry associations and awaken emotional recognition. Statistics seem bare. The inadequacy of statistical knowledge is like the inadequacy of theology to the religious. The artist that is in us wants understanding rather than statistics. But understanding is hardly knowledge; it is rather what knowledge means to us, i.e., to our rich collection of associations. Knowledge and understanding are at opposite ends of a continuous distribution. How many of us have an understanding of how far 93,000,000 miles are? Yet to know that the sun is that far away is very useful knowledge. Numbers as well as statistical symbols do not yet carry meanings as readily as does the folk language. The problem of the meaning, and presentation of statistics is most important as Mr. Leonard Ayres showed so clearly in his presidential address before the Statistical Association a few years ago.

The tests of knowledge are reliability and accuracy, not understanding. Indeed it is quite possible to have a satisfying understanding of something that doesn't exist. Thus one may understand how the sun moves around the earth. A person, untrained scientifically may live for a long time among another people and come to have a very good understanding of them; yet he would scarcely be called a scientist. His understanding would not be of that accurate, systematic, transferable kind called science. And so there would always be uncertainty as to how much he had misrepresented reality, unless it has been placed in objective verifiable form. To a visitor, Scandinavians may be tall, blue-eyed blonds with long heads and long faces, yet science shows that such an observation is a distortion of reality, for only about fifteen per cent of them fit this description.

Understanding comes to the extent that knowledge is correlated with past experiences and associations. Poets and novelists are much more successful in conveying understandings than statisticians and psychologists. This lack of appreciation of the difference between knowledge

and understanding is thought to be the reason for much of the argument that the scientific procedures in the social sciences must be fundamentally different from those in the physical sciences. Statistical knowledge is peculiarly disappointing to those who fuse emotion with knowledge. The inadequacy of statistical knowledge is not so much a problem of statistics as it is a problem of the diffusion of statistics. This inadequacy is the very cause of its success, which rests on the fact that it is practical. Artists, poets, musicians and children are notoriously impractical, for reality to them is an inner reality. The statistician is essentially practical, interested in the outer reality and in eliminating the biasing effect of the inner feelings.

This close connection between statistics and the reality of the outside world explains a good many aspects of statistical development. For instance, it explains why certain impractical mathematicians do not make good practical statisticians. It also explains why statistics in psychology is different from statistics in economics. Statistical method must vary according to subject matter. Hence, statistics must be taught in the various departments of universities where it is applied. For these reasons statistics tends to break up into separate disciplines, somewhat as philosophy did. This tendency, by the way, may be of some significance for the future of the American Statistical Association. For instance the Statistical Association may take over the statistical activities of the other social science associations, or these associations may take over the jurisdiction of statistics dealing with their subject matter with the result that the Statistical Association confine its activities largely to methodology. The chief obstacle to the latter development is that methodological inventions arise from attacks on specific kinds of subject matter and cannot be developed apart from the special social sciences. Another possibility is that the Statistical Association may expand in such a way as to sweep more and more different subjects into its orbit, developing sections on medical statistics, engineering statistics, psychological statistics, biological statistics, in which case statistics will appear in the rôle of the unifier of the social sciences, perhaps as the one great social science. The rapid extensions of statistical technique into the various disciplines during the past decade are in this direction.

Before closing it may be well to affirm, lest there be misunderstanding, that accuracy and verification are not the whole story of science nor of statistics. It is quite recognized that hypotheses have to be formulated and that there is a drive back of research which calls for the constructive imagination of the artist, without which there could be no research. And it is also recognized that the aesthetic satisfaction that

comes after a beautiful piece of research is somewhat akin to that which the artist experiences.

In conclusion, then, the apology for pausing a while this evening to reflect on the nature of art and of statistics lies in the great prevalence of the distorting tendencies of the human mind particularly in the social field and the great success which statistics has in combating these tendencies. We "carry around in our heads" pictures that are not like the photographs of reality. As children we begin life as artists personifying nature. We grow up still twisting reality out of shape with our faith and belief, as idealists, optimists, and pessimists, nervous, full of imaginary fears, doing all we can not to see life accurately. And in the occupations we follow we are bent on further twisting reality. As leaders, social reformers, religionists, journalists, entrepreneurs, promoters, advertisers we want to distort reality in ways peculiar to each occupation. As human beings we all wear colored glasses. This is the material nature has given us out of which to make scientists. No wonder they are so scarce.

It may be noted as a sort of complement to this array of human nature that the business of society can stand only a very few scientists and still fewer statisticians, perhaps not more than a fraction of one per cent. Nor does a statistician want to be a scientist more than a part of each 365 days. But we do need the results of statisticians, and in order to get them we need good scientists, not cross breeds.

Next, let us look at some of the issues on which we want scientific knowledge. There is war. One can hardly think of it without getting emotional. The word, war, almost suggests misrepresentation of facts. Another problem is the distribution of wealth, the factors surrounding which are so easily colored by our prejudices. Other problems with which we should deal, without distorting them, are strikes, labor unions, political parties, communism, religion, sex, the family, women, parents and children, races, tariffs, monopolies, eugenics; all problems capable of arousing the most violent prejudices. It is not surprising therefore that in the social sciences the forces of art have overshadowed statistics.

Nature, the subject matter of natural sciences, was once distorted and colored. The stars were candles hung out by the angels; thunder the voice of an angry deity. Strange as it may seem, nature was once the happy hunting ground of the wishful thinkers. But science succeeded in neutralizing it. We do not see ghosts, gnomes and fairies any more; and, parenthetically nature is still just as beautiful to the artist.

Can the neutralization of society be accomplished by the colorless statistician and scientist? For instance, shall we cease to personify

social forces as great men and heroes? Shall we quit thinking of the Negro and the Eskimo as being inferior in mental ability? Shall we de-personalize heredity and admit that it has little or nothing to do with personality of normal human beings? Whatever the measuring scientist may find, the artist in us has given him a first rate task to do in regard to social institutions and their functioning. It is only desirable that society become neutralized to us as statisticians, not as artists or as human beings. Finally, however forbidding the neutralization of society may be, the reward is knowledge, control and power.

SEASONAL PATTERN AND SEASONAL AMPLITUDE: MEASUREMENT OF THEIR SHORT-TIME VARIATIONS

By Simon Kuznets, *National Bureau of Economic Research*

For a number of years statisticians have been concerned with the problem of measuring changes in the seasonal behavior of time series. But their attention has been concentrated on changes that were either gradual in character, or, if abrupt, demarked a break from one stable seasonal period to the next. To measure the latter was simple, for the stable seasonal indices could be computed for the period preceding and succeeding the break. Gradual changes, however, presented some difficulty. This was solved by applying the methods of determining secular movements to data which were so corrected as to throw into relief the seasonal element, i.e., were freed as much as possible from the secular trend, cyclical movements and sometimes even random changes.

But besides such variations in seasonality, two other groups of changes appear, upon close study of the seasonal problem, quite important: (1) the short-time shifts in seasonal pattern, pattern being defined as the relative seasonal position of the months in the year, regardless of the general amplitude of the seasonal swing; (2) the short-time shifts in seasonal amplitude. Both groups of changes are confined to variations, irregular in character, that reveal themselves within a comparatively short period. This irregularity within short spans of time is distinctive and calls for new methods.

Short-time shifts in seasonal pattern, to consider the less important group of changes first, occur quite frequently, and their existence can be ascertained rather easily. The best example is provided by the shift of the Easter holiday from March to April and its influence on retail sales. The effect on department store sales has been measured empirically by the Federal Reserve Board statisticians.[1]

Such shifts in seasonal standing which may occur from one year into the next, without any regularity, are characteristic of many more groups of series than might at first be thought. All the time series which reflect the movement of agricultural crops are subject to them. In one year wheat may begin to be marketed late in July, the next year in August, the third year in early July. The cotton crop may begin to be harvested in one year during August, in the other in September. Such shifts obviously arise from the climatic conditions in the central geo-

[1] See this Journal, December, 1927, pp. 493–496.

graphic belt which supplies the bulk of the crop and which one year may make for an early crop, the other year—for a late crop. In addition, there are cases in which the crop comes from two distinctly different geographical sources (e.g. spring and winter wheat) which have normally quite different harvesting dates. Then the shift in the proportion of the two sources of the crop may affect the seasonal pattern (and sometimes even the seasonal amplitude) of the series which reflect the movement of the commodity as a whole.

Thus short-time shifts in pattern affect all the numerous time series that deal with the flow of agricultural crops to markets, shipments of crops from central markets, exports and stocks of crops at the primary stages of distribution, etc. But a similar group of seasonal factors may affect the series which portray seasonal variations in consumers' demand due primarily to climatic conditions. To take an extreme example, the sales of straw hats, allowing for constancy of demand, may begin about the middle of May, or in early June, depending upon the particular weather conditions in the given year. Shifts in the exact date at which the new climatic season is really ushered in will affect the seasonal pattern in the sales of apparel, consumption of seasonal foods, sometimes even the beginning of construction operations, shipping on lakes, etc.

The importance of these short shifts in seasonal pattern, and correspondingly the complexity of their measurement, depends upon whether one conceives this shift as affecting only a couple of months or all twelve months with which the seasonal measurement deals. If, as in the case of Easter, the shift is supposed to affect the seasonal standing only in March and April, this type of seasonal changes becomes limited in significance. The measurement then is reduced to an adjustment for these two months, derived from comparison of the seasonally corrected data (by a stable or a progressive seasonal index) for various subperiods, distinguished by the dates of the disturbing holiday. In some cases, however, it might be argued that the shift in the beginning of a climatic seasonal affects the standing of more than just the preceding and current month. In this case, one way out is to break the series into subperiods, within which there is no shift in the seasonal factor affected, and compute separate seasonal indices. The other alternative, the measurement of the seasonal factor by a continuous time series, and elimination of seasonal effects through correlation, seems to be impracticable.

The second group of changes appears more important in character, and is at the same time capable of more precise measurement.

These are changes in seasonal amplitude from year to year. A brief survey of the seasonal factors that make for such changes will illustrate their pervasive character. The best example is provided by a series which measures stocks of an agricultural commodity, such as cotton.

Stocks of cotton at public warehouses (or at mills) in the United States show a seasonal swing of a rather considerable amplitude. The seasonal declines constantly from the beginning of the calendar year to about the end of July or August, and then, as the new crop comes in, rises to a peak in November or December. The amplitude of this seasonal in a given year will depend upon a number of factors of which the most important seem to be as follows: (1) the relative size of the crop in the corresponding year as compared with that of the current year; (2) the demand for cotton during the current year; (3) the absolute volume of stocks during the current year, especially as compared with the average size of crop of the current and the preceding years. If the last year's crop was poor, if the demand (both domestic and export) during the current year was large, if, in consequence of these two factors or for some other reason, the absolute level of the stocks during the first three quarters of the current calendar year was low, and if the current year's crop is comparatively good, the seasonal swing of cotton stocks during the given year, measured by a relative seasonal index (running in terms of deviations from 100) will be large. If on the other hand, the preceding year's crop was large, if the demand during the given year was rather small, if in consequence of these two factors, or for some other reason, the absolute volume of stocks during the first three quarters of the year was large, and if the current year's crop is rather poor, the relative seasonal index during the given year will obviously have an amplitude much smaller than the average. Such fluctuations in seasonal amplitude, with the pattern persisting, might occur without any gradualness or regularity from one calendar year to the next. No matter how short the period for which the stable seasonal index is computed, and it should not be shorter than four or five years, it can hardly cover a period within which such fluctuations in amplitude are absent. And it is also clear that no method of studying progressive seasonality will measure the fluctuation. What is needed is an index which will reflect irregular, year-to-year changes in seasonal amplitude.

The same factors that thus determine variations in seasonal amplitude in stocks of cotton will affect the seasonal swings in the flow of cotton from farmers to the cotton houses, exports of cotton from the United States and even the consumption of cotton by the textile mills. In the case of all agricultural raw materials, seasonality in supply is reflected not only in the flow and stocks of the commodity in its raw

form, but to a certain extent even in its consumption by the industrial user. In all the numerous time series which record this activity, there will be fluctuations in seasonal amplitude from year to year, arising from the variations in the size of crop, the geographical distribution of the crops, and sometimes the fluctuations in the size of the carryovers.

On the other hand, series which reflect seasonality in final demand due to the direct influence of climatic conditions will be subject to the same type of variation in seasonal amplitude. In a year marked by both mild winter and comparatively cool summer, the seasonal swing in the sales of cool drinks, electric fans, and light apparel will not be as marked as in a year which has a very hot summer and a rather cold winter. The demand for a very considerable number of commodities is variable because it reflects the succession of climatic seasons. And any changes in the seasonal amplitude of the climatic conditions will tend to be reflected in the seasonal variation of the corresponding time series.

Seasonal variations in the supply of raw materials and the demand for finished goods tend to be reflected in the industrial consumption of raw materials, industrial production of finished goods, stocks and flow of both groups of commodities. Any variations in seasonal amplitude in the supply of raw materials or the demand for finished goods will, therefore, tend to be passed on through the numerous ramifying links of the economic system. But, besides, there is an additional group of factors which determine the extent to which seasonality in supply of materials or demand for finished goods is allowed to influence the flow of industrial production or intermediary stocks. These factors constitute, therefore, an independent source of possible variations in seasonal amplitude.

Thus, for example, the adoption of hand-to-mouth buying policy by retailers and wholesalers of manufactured goods means that orders or purchases on the part of these two business groups begin to reflect much more closely than before the seasonal variations in the demand for final consumers. If before the inauguration of such a policy, dry goods' retailers and wholesalers bought ahead of the season and spread their orders throughout the year, after the new policy came in, retailers' and wholesalers' purchases reflect fully the seasonality of consumers' demand which then falls with full brunt on the manufacturers. Here is, therefore, a change in seasonal amplitude in the purchases by retailers and wholesalers, in shipments to them, in stocks kept by them. In his turn the manufacturer, faced with this situation, may either keep larger stocks and thus take over the function performed before by the trades, or allow production to become more seasonal, i.e. produce just when orders come in. In this case we should observe a

change in seasonal amplitude in the stocks kept by manufacturers, or in industrial output itself.

Now, such changes in business policy may occur from one year to the next. The degree to which the uncontrollable seasonal variations in the supply of raw materials and the demand by final consumers are allowed to affect the controllable processes of industrial manufacturing and of trading, depends very much upon the general factors which determine the keeping of stocks, either in the form of commodities or in the form of machinery. And these factors may vary from year to year, producing corresponding changes in seasonal amplitude. We are thus likely to, and actually do, find variations in seasonal amplitude not only in series which reflect directly uncontrollable climatic seasons, but even in series which measure controllable business activity.[1]

It might be said that all these changes in seasonal amplitude are not seasonal changes at all. It might be pointed out, and with some basis, that variations in seasonality due to factors just discussed are really a reflection of the cycle in the supply of crops, in the demand for the seasonally affected commodities, or in the factors determining business planning. This is true. But while the originating factors may be cyclical in character, the result is to produce discontinuity in the monthly data, a discontinuity directly associated with the seasonal behavior of the series. By failing to correct for these effects, we fail to eliminate properly the seasonal variations in the series. One may call these variations in seasonal amplitude the effects of cycles on the seasonal. But these effects have to be measured, if one wishes to learn their magnitude, obtain a clear indication as to the factors which may explain them, and correct the series so as to attain better continuity and smoothness for the purpose of better studying the cyclical or other continuous elements.

How can these year-to-year changes in seasonal amplitude be measured? The answer lies in the suggestion made some years ago by the Russian statisticians, Bobrov[2] and Tschetverikov to use the coefficient of regression.

If we compute either a stable or a progressively moving seasonal for a series, we may assume this seasonal to represent the independent variable, to be called s. The task then is to find out whether in any given year the series reflects the full seasonal amplitude of the stable or progressive index, only a part of it, or perhaps an amplitude in excess of it. In order to answer this question the data must first be treated in

[1] See W. Floyd Maxwell, "Revised Index of the Volume of Manufacture," *The Review of Economic Statistics*, May, 1929, pp. 69–70.

[2] See S. P. Bobrov, *Economicheskaya Statistika*, pp. 429–30, Moscow, 1930.

such a way as to throw into relief the seasonal changes and to reduce as much as possible the secular and cyclical movements. This may be accomplished by computing a twelve-months moving average, or a two of a twelve (which amounts to a thirteen-months moving average, extreme months at half weight). The dependent variable is then the original series, taken as relative of the moving average as 100. Let us call this variable d.

Then, for a given calendar year the coefficient of regression is

$$b_{ds} = \frac{\Sigma ds}{\Sigma s^2}.$$

To compute the formula, we take for s the deviation of the seasonal index from 100 (these are deviations from the true mean, since the seasonal index is centered on 100); for d the original data expressed as relative of the moving average, but taken as deviation from 100 (this is a deviation from an assumed mean, since only rarely will the deviations from a twelve-months moving average exactly balance during the year). What the formula yields then is the unit change in the data with a unit change in the seasonal index. If the coefficient is equal to 1, the seasonal amplitude during the given year is exactly equal to the seasonal amplitude of the stable seasonal index (or the progressive seasonal for that year.) If the coefficient is less than 1, the seasonal amplitude during the given year is smaller than that of the stable seasonal index. If the coefficient is larger than 1, the seasonal amplitude is larger than the average.

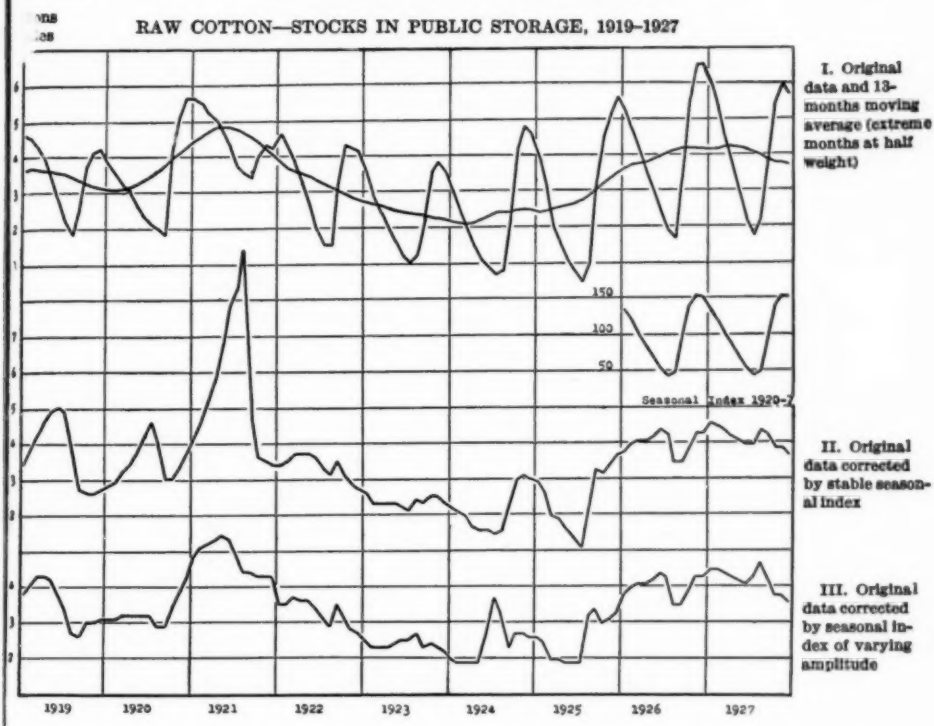
An example of computation for one year, 1924, of this coefficient of regression or *amplitude ratio* is given in Table I, for the series of cotton stocks in public warehouses.

TABLE I

Months	Original data (millions of bales)	Moving average (13 months)	Relative deviation d (per cent)	Seasonal index (years 1920–27) taken as deviation from 100) s	Products ds	s^2
January	2.96	2.16	+37	+35	+1295	1225
February	2.50	2.13	+17	+20	+ 340	400
March	2.00	2.11	− 5	+ 2	− 10	4
April	1.51	2.14	−29	−13	+ 377	169
May	1.13	2.21	−49	−30	+1470	900
June	0.88	2.30	−62	−45	+2790	2025
July	0.67	2.39	−72	−55	+3960	3025
August	0.80	2.45	−67	−51	+3417	2601
September	2.07	2.47	−16	− 7	+ 112	49
October	4.23	2.48	+71	+39	+2769	1521
November	4.80	2.48	+93	+53	+4929	2809
December	4.62	2.48	+86	+52	+4472	2704

$\Sigma d = +4 \quad \Sigma s = 0 \quad \Sigma ds = +25{,}921 \quad \Sigma s^2 = 17{,}432$

$$b_{ds} = \frac{+25{,}921}{17{,}432} = +1.487$$



The importance of this factor of varying seasonal amplitude may be seen from a glance at the chart. The upper section presents the original data with the two item average of a twelve-months moving average passed through it. The importance of the seasonal swing is quite apparent. The stable seasonal index is derived from the deviations from the line of moving averages.

The second section of the chart is the original data corrected by the stable seasonal index. While a large part of the seasonal swing has been taken out, some of it remains, as may be seen from an inspection of the chart, especially in comparison with the seasonal pattern plotted there. In some years, such as 1924 and 1925, the corrected data retain a movement positively associated with the stable seasonal pattern. In these years the seasonal amplitude must have been larger than the average, and as a result, the application of the stable seasonal index has "undercorrected" the series. In other years, such as 1921 and 1920, the corrected data exhibit a movement directly inverted to the stable seasonal pattern. In these years the seasonal amplitude must have been smaller than the average, and as a result, the application of the stable seasonal index has "overcorrected" the series. It is to be seen

that no matter how short the period for which the stable seasonal could be computed, no correction for this shifting amplitude would have resulted. Neither can a progressively moving seasonal deal with the problem.

The coefficients of regression, or, as they might be called in this case, the amplitude ratios, may help to correct this improper elimination of the seasonal. For the period covered by the chart, the amplitude ratios for successive calendar years were as follows:

1919....	0.62	1922....	0.94	1925....	1.32
1920....	0.63	1923....	1.13	1926....	1.01
1921....	0.42	1924....	1.49	1927....	1.05

We can apply these ratios to the deviations of the stable seasonal index from 100, and thus obtain new seasonal indices for each calendar year. Thus for the year illustrated above, the amplitude ratio was 1.49. Applying it to column 5 we obtain the following seasonal index for the year 1924:[1]

Months	Deviations from 100	Index	Months	Deviations from 100	Index
January	+52	152	July	−82	18
February	+30	130	August	−76	24
March	+ 3	103	September	−10	90
April	−19	81	October	+58	158
May	−45	55	November	+79	179
June	−67	33	December	+77	177

The correction by these new indices gives us the line in the bottom section of the chart. It may be seen that the series is now much better corrected for seasonal than before.

The use of the coefficient of regression as illustrated above is contingent upon the fact that the seasonal pattern will be reflected persistently from year to year and that only the seasonal amplitude changes. It is assumed that the other changes in the deviations from the twelve- or thirteen-months moving averages, besides the seasonal, are distributed in a way indifferent to the seasonal pattern, and that the seasonal is the most important element of change there.

However, these other factors may affect the seasonal pattern in any year. If for a given year, a low amplitude ratio or coefficient of regres-

[1] In computing the new seasonal index by the application of the amplitude ratio a difficulty may arise when the ratio is very large. For then the negative deviations of the stable seasonal index from 100 in some of the months, when multiplied by the amplitude ratios, may become close to −100 or sometimes even less. In such cases it might be better not to divide by the seasonal index, but to subtract its deviations from 100 (adjusted by the amplitude ratio) multiplied by the average value of the series for the period. If the seasonal index for some month becomes algebraically smaller than −100, it might be taken as −100. The corrected series thus becomes discontinuous for this month.

sion is obtained, this result might be due either to the fact that while the seasonal pattern persisted, the amplitude during the given year did decline, or to the fact that there had been a shift in seasonal pattern during the year. For purposes of correction, as demonstrated above, the distinction is not important. But for purposes of interpretation of the movement of these amplitude ratios from year to year, it is of importance. And it is only a short step from the coefficient of regression to the measure which would indicate whether the pattern itself persists from year to year, viz. the coefficient of correlation.

The coefficient of correlation measures the association between the variations of the two variables, regardless of their average amplitude. Hence, it will show whether or not the pattern indicated in the stable seasonal index is reflected closely in the movement of the data taken as deviations from the thirteen-months moving average. The formula for this coefficient in the terms above is

$$r = \frac{\Sigma ds}{\sqrt{\Sigma s^2(\Sigma d^2 - C^2)}}.$$

The correct sum of ds and of s^2 is given in the computation of the amplitude ratio, and the sum of d^2 can be easily computed from Table I. The correction C is given by the algebraic sum of the d's taken for the year. This algebraic sum is found in column 4 of Table I.[2]

The r's for the years covered in the illustrative chart are as follows:

1919....	0.89	1922....	0.89	1925....	0.98
1920....	0.95	1923....	0.98	1926....	0.98
1921....	0.89	1924....	0.98	1927....	0.99

It may be seen that the values are very high throughout, and that therefore the variations in the amplitude ratios may be conceived as bona fide changes in seasonal amplitude, with the permissible assumption of a highly persisting pattern.

The amplitude ratios, indicated above, supported by the corresponding r's, may be computed not only for successive complete calendar years, but for any successive complete years of twelve months each. Instead of counting the year from January to December 1920, one may count from February 1920 to January 1921, March 1920 to February

[2] It might be objected that the use of the Pearsonian r for correlating the stable seasonal swing and the swing observed in each current year is improper, since the case involves measurement of annual cycles, and not distributions of the normal type. Consequently, it ought to be more advisable to use first moment correlation, or some such measure as the index of similarity of Gressens and Mouzon. (See this JOURNAL, December 1927, pp. 483–492.) But these measures do not employ the concept of regression and do not provide the proper coefficient of regression. And since a measure of the latter type is needed for the amplitude ratios, it might be better to use the established indices, with full regard, of course, for the possible influences of extreme items.

1921, etc., and thus obtain both amplitude ratios and r's for years removed by one month successively. Thus, for the period covered by the chart the amplitude ratios and the r's for years running from July to June are as follows:

Years	Amplitude ratio	r	Years	Amplitude ratio	r
1919–20	0.66	0.96	1924–25	1.57	0.98
1920–21	0.53	0.82	1925–26	1.14	0.98
1921–22	0.55	0.96	1926–27	1.06	0.99
1922–23	1.00	0.98	1927–28	1.02	1.00
1923–24	1.22	0.99			

This change from the calendar year involves certain complications if one wishes to use the resulting amplitude ratios for a better correction of the series. First, if the underlying seasonal is moving instead of stable, the seasonal indices for non-calendar years will not be centered on 100, and therefore a correction of the s's in the computation of the amplitude ratio and of the r is needed. Secondly, even if a stable seasonal is used, the correction of the seasonals on the basis of amplitude ratios running in non-calendar years is difficult, because the corrected seasonal index ceases to be centered on 100. Thus, if for adjusting the seasonal standing for January one uses the amplitude ratio for the year running from July 1920 to June 1921, and for adjusting February 1920, the year August 1920–July 1921, the changes in the amplitude ratio may result in the fact that the amount of adjustment introduced into the twelve months of 1920 does not balance algebraically. Of course, the same difficulty is true of non-calendar years even when we adjust by amplitude ratios based on calendar years only. The adjustment introduced into the year July 1920–June 1921 is not likely to balance. We have here the same situation that is created by a progressively moving seasonal correction. Only for one set of years can the seasonal correction balance. But in using the moving amplitude ratios not even one set of years will have a seasonal correction centered on 100.

For this reason the use of moving amplitude ratios for correction is not altogether practicable. But they are more important in throwing light on the movement of seasonal amplitude itself, a measurement of a new type of change which may turn out to be of considerable analytical interest. For the amplitude ratios permit the study at close range of the shift in the seasonal perturbations of the economic activity which is reflected in the time series. It permits the establishment of any shifts in seasonal variations from one link of the distributive system to an-

other; of changes in seasonal amplitude within much shorter periods of time than can be covered by stable seasonal indices. To put it differently, the amplitude ratios buttressed by the r's permit study of the short-time changes in seasonal swings, variations which may be primarily interpreted as the short time, retroactive effect of the cyclical movements on the seasonal recurrence patterns.

In conclusion it might be interesting to present a set of measures for a connected group of series. In Table II, for series reflecting movement of hogs, stable seasonal indices were in most cases computed for two periods. But the amplitude ratios have been rendered comparable by recomputing them to the base of the average sigma of the deviations of the stable seasonal indices from 100.

TABLE II

AMPLITUDE RATIOS AND r's FOR THE SEASONALITY IN RECEIPTS, SHIPMENTS AND COMMERCIAL SLAUGHTER OF HOGS, 1919–1929

Years (calendar)	Receipts at primary markets		Shipments from primary markets		Commercial slaughter		*Average price per 100 pounds at Chicago (year beginning October)
	Amplitude ratio	r	Amplitude ratio	r	Amplitude ratio	r	
1919	1.37	0.99	1.26	0.96	1.32	0.99	14.65
1920	1.17	0.93	1.06	0.94	1.09	0.93	9.66
1921	0.90	0.97	1.27	0.95	0.77	0.95	9.01
1922	0.80	0.98	1.02	0.93	0.73	0.92	7.93
1923	0.81	0.97	0.79	0.95	0.77	0.95	7.58
1924	1.19	0.93	1.20	0.91	1.09	0.94	11.59
1925	1.14	0.94	1.16	0.91	1.00	0.92	12.18
1926	0.67	0.97	0.76	0.93	0.70	0.97	10.70
1927	0.65	0.78	0.54	0.79	0.70	0.82	9.58
1928	1.27	1.00	1.02	0.92	1.23	0.90	10.20
1929	0.83	0.94	0.82	0.95	0.85	0.95	

* See *Yearbook of Agriculture*, 1930, p. 853.

The similarity of the amplitude ratios in the three series, as well as the consistently high values of the r, indicate that we are dealing here not with any vagarious result of statistical manipulations but with a measure, approximate though it may be, of a significant group of changes. This impression is confirmed when the course of prices, given in the last column of the table, is compared with the movement of the amplitude ratios. The agreement in the movements is quite striking. When prices go down, as they did in the years 1920 to 1923, the amplitude ratios decline also. When prices go up, as they did in the years 1924 and 1925, the amplitude ratios, in at least two of the series, show a rise. The same agreement occurred during the rise in prices in 1928. It would seem then that with declining prices there is less of a concen-

tration of hog movements in the seasonally heavy months, and relatively larger volumes of hog shipments in the other, seasonally slack, months. Such a result may be explained by a waiting policy on the part of the producer, by a greater inclination to wait with the marketing of hogs in periods of declining prices. On the contrary, in periods of rising prices there is a tendency to ship more in the seasonally high months, obviously in order to take advantage of the favorable markets as promptly as possible.

Table II provides a good case in which fluctuations in seasonal amplitude seem to be a direct effect of changing business conditions and of consequent changes in business policy on the part of economic agents. In view of this nature of the variations in seasonal amplitude, they present considerable interest from the point of view of an economist. The quantitative, absolute magnitude of these changes may be small, although in agricultural series they are often considerable. But they throw light on significant economic phenomena and their implications. For this reason, the National Bureau of Economic Research, in its study of Seasonal Variations in Industry and Trade, lays some emphasis on measuring these variations in seasonal amplitude. It is hoped that the results will justify attention to these groups of changes and thereby contribute to a greater knowledge of the underlying economic factors.

INDEXES OF THE PHYSICAL VOLUME PRODUCTION OF PRODUCERS' AND CONSUMERS' GOODS [1]

By Y. S. Leong, *The Brookings Institution*

Two attempts have been made to measure the production of consumers' goods and of producers' goods by months. Snyder, in constructing his index of the "Volume of Trade," subdivides his production series into two groups, for which he builds up two distinct indexes, which he designates as "Producers' Goods" and "Consumers' Goods."[2] The Harvard Economic Society's monthly index of the Volume of Manufacture in its earlier form appeared as a combination of three sub-composite indexes measuring the physical volume of output of (1) basic materials, (2) equipment and vehicles and (3) consumption goods.[3] But both Snyder's and the Harvard Society's measurements are not strictly indexes of production in the same sense as are our measurements of price levels, which are weighted averages of prices converted into relatives, but are really indexes representing the production cycles of these types of goods, for the method of construction consists in ascertaining the trend of each series and in taking the weighted arithmetic mean of the relatives, computed on the basis of their respective ordinates of secular trend adjusted for seasonal variation equal 100.

There is still room, then, for the construction of monthly index numbers to measure the actual changes in the physical volume of production of the two types of manufactured goods in the United States, and it is the object of this paper to present two sets of measurements: an index of the volume of producers' goods and an index of the volume of consumers' goods, for the years 1919–1929. By combining these two measurements we obtain the index of manufactures. For reasons which are shown below, it seems desirable to present a separate index of the volume of consumers' goods from which automobile production is

[1] The writer wishes to acknowledge his indebtedness to Dr. C. O. Hardy of the Institute of Economics and to Mr. D. S. Thompson of the Division of Research and Statistics, Federal Reserve Board, for advice and suggestions; to the Brookings Institution for statistical aid and for the grant of a research fellowship which made this study possible; to Mr. S. B. Akers for supervising the computations and to Mr. R. P. Ward for drawing the charts.

[2] Carl Snyder, "The Index of the Volume of Trade, Second Revision," this Journal, June, 1928, Vol. XXIII, pp. 154–163.

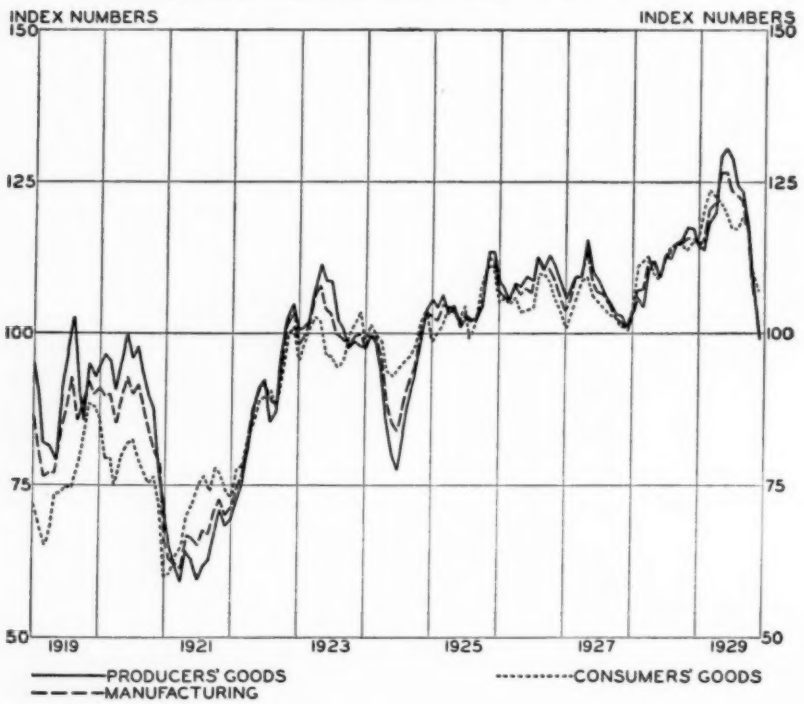
[3] E. E. Day, "Cyclical Fluctuations of the Volume of Manufacture," *Review of Economic Statistics*, January, 1923, Vol. V, pp. 30–60. In the recent revision of its index of the volume of manufacture, the Harvard Society has abandoned its former classification, preserving only the basic material grouping. See W. F. Maxwell, "The Revised Index of the Volume of Manufacture," *Ibid.*, May, 1929, Vol. XI, pp. 68–109.

excluded. For comparative and other purposes it is also deemed instructive to adjust these four indexes in their final form for trends and seasonal variations. The actual indexes[1] of producers' goods, of

CHART I

INDEXES OF THE PRODUCTION OF PRODUCERS' GOODS, OF CONSUMERS' GOODS AND OF MANUFACTURES

(Adjusted for Seasonal Variations—Average, 1923–1925 = 100)



consumers' goods and of manufactures are shown in Chart I, the same indexes in adjusted form (trends eliminated) in Chart II. The figures underlying the charts are given in the appendix. The data which enter into the indexes, their sources, the weights assigned and the relative importance of each series as shown by the percentages computed on the basis of the weight assignments are also presented in the appendix.

We have selected sixty monthly physical unit series, covering twelve industrial groups.[2] Because our indexes are of historical in-

[1] The actual indexes in Chart I and the adjusted indexes in Chart II are corrected for seasonal variations.

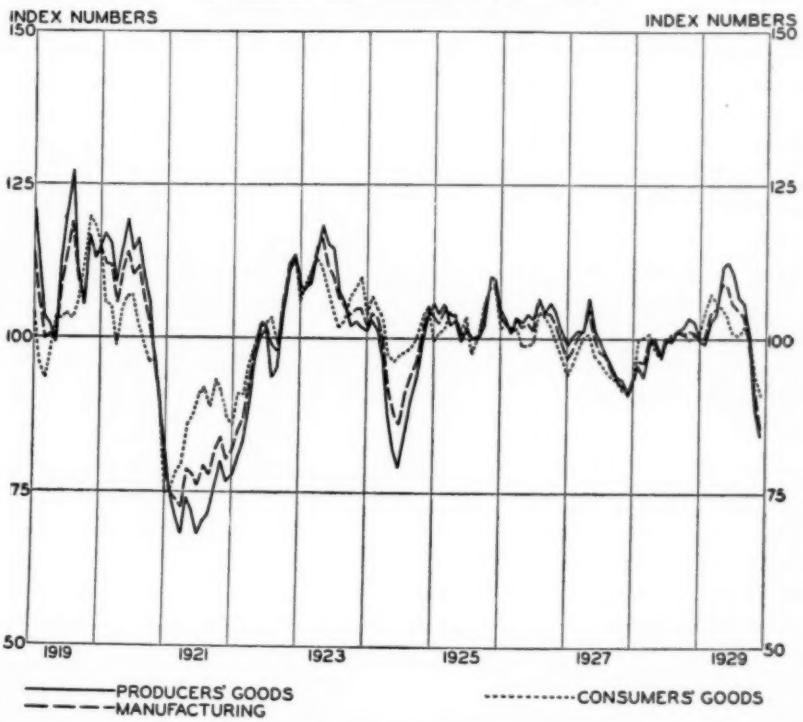
[2] In making the study of the underlying statistics for the indexes, I am indebted for assistance and suggestions to a number of persons connected with the various government bureaus. In particular, ac-

terest rather than for current use, we are able to broaden their scope to the greatest possible extent by including a number of series which the compiler of indexes for current use must discard either because the

CHART II

INDEXES OF THE PRODUCTION OF PRODUCERS' GOODS, OF CONSUMERS' GOODS AND OF MANUFACTURES

(Adjusted for Seasonal Variations—Normal = 100)



data are not promptly published or because, though currently available, they are subject to later revision. Considered purely from the numerical standpoint, the inclusion of sixty out of the hundreds of industries manufacturing thousands of products cannot be said to be entirely adequate. Fortunately for our purposes most of our series are relatively important—important as measured by the values added by manufacture and as judged by the fact that they may be taken to represent directly or indirectly the output of a large number of products

knowledgment is due to Mr. J. F. MacDonald of the *Survey of Current Business* for furnishing me with the latest revised figures compiled by his office; to Dr. C. E. Parry and Miss A. Joy of the Division of Research and Statistics, Federal Reserve Board, for supplying me with certain series; and to Mr. LeVerne Beals, Chief Statistician, Census of Manufactures, and others connected with the Bureau of the Census, for advice with respect to the reliability of certain production data.

of industries for which we have no data, and of whose broad movements our component series may be trusted to give us a fair approximation.[1] We do not, for example, have any satisfactory statistics of machinery produced, or of finished or semi-finished steel products, but we may rely upon the output of steel ingots to give us indirectly a general indication of the concurrent movements of these industries into which steel ingots largely if not wholly enter as basic material. Certain of our series, which while satisfactory in so far as they may be taken as broad measurements of the productive activities of those industries manufacturing unfinished products, are not so useful for the purpose of representing the changes in those industries which are engaged in the more advanced stages of fabrication. For example, in the textile industries, for which we have practically no production figures, the substitution of data showing the volume of basic raw materials consumed currently, while it may be serviceable for the purpose of registering the output of yarn and unfinished cloths, is not to be depended upon because of changes in quality to reflect the changes in the manufacture of finished cloths and clothing. Still less may it be relied upon to give us a trustworthy picture of the variations in the volume of the finished products of related industries fabricated from new materials, of which we have not even consumption data, such, for example, as the rayon industry.

Having selected the basic data, we must next classify the series into producers' goods and consumers' goods. As the distinction between the two types of goods is not a clear one, our classification in some cases must necessarily be more or less arbitrary. For our purpose, we designate those series which are intended to represent fabricated goods for immediate or near to immediate consumption as consumers' goods, such as flour, and those other series which are intended to represent unfinished goods, such as yarn, or goods which are used to produce other goods, such as machinery, as producers' goods. On the basis of this distinction we have divided our sixty series into the two groups —29 as consumers' goods and 31 as producers' goods. An examination of the items of the two groupings will make evident the fact that the producers' goods index is more comprehensive than the index of consumers' goods. This shortcoming of the consumers' goods index is to be explained by the fact that we are unable to obtain satisfactory statistics of the output of fully fabricated goods and that hence we are forced to substitute data showing the production of simple articles and in some cases, figures representing the amount of raw materials cur-

[1] The average value added by manufacture in all industries for the census years of 1923, 1925 and 1927, computed from the biennial census figures amounts to $27,000,000,000, of which amount, $13,000,000,000 or 48 per cent is directly, and $21,000,000,000 or 78 per cent is directly or indirectly represented by our sixty series.

rently consumed by the industries. Of course, where the industries, as in the iron and steel industries, manufacture goods largely of the producers' type, in which the time relationship and the magnitude of cyclical movements of the simple as well as the elaborated products are practically similar, data measuring the changes in the volume of goods of lower orders may well be substituted, in the absence of better and more refined figures.[1] But in other industries, which produce both types of goods and of which the final products are largely destined for final consumption, the use of crude data, such as figures of current consumption of raw materials, to represent consumers' goods is questionable. Undoubtedly the scope of our index of consumers' goods should be extended to include additional data of fabricated products for direct consumption. In particular, we need direct production statistics of hardware and machinery for household use, wood and other household furniture, musical instruments, drugs and chemicals for ultimate consumption, canning and preserving and cloth and clothing.

The index of producers' goods, being broader in scope and having included in its composition more reliable component series, is undoubtedly a more trustworthy gauge of the producers' type of production than is the index of consumers' goods of the consumers' type. Only three of the larger industries—the chemical, the clay products and the railroad repair shops—are without direct or indirect representation in the index; of these, the chemical is the most important. To be sure, in some industries, the measurement of their productive activities is possible only indirectly; for instance, machinery production is represented only indirectly by the concurrent output of iron and steel. But despite these shortcomings, we can perhaps safely conclude that our index of producers' goods is as comprehensive and as representative a measure as can be devised at this time to register the movements of the output of the producers' type of goods.

The classified individual series are next combined into composite index numbers by the "aggregative" method.[2]

Our system of weights is based upon the figures showing "value added by manufacture," presented biennially by the Census of Manufactures. As some of our series represent more important industries than do others, and as others cover a greater proportion of the industries which they represent than do others, it has been found necessary to assign

[1] Production statistics of lower order of goods do not of course register the degree of fabrication of higher order of goods. Consequently the use of crude data to represent the production of consumers' goods, whose quality is improved from year to year, is certain to understate their long-time growth.

[2] This method is employed by the Federal Reserve Board in computing its "Index of Industrial Production" (*Federal Reserve Bulletin*, March, 1927, Vol. XIII, pp. 173–175), and by Perry and Silverman in constructing their index of the "Physical Volume of Canadian Business" (this JOURNAL, June, 1929, Vol. XXIV, p. 137).

a weight to a given series to register its importance, that is, the value added by the manufacturing process to the industry which it represents, and to impute additional weight to represent value added either in related industries, or in the later stages of fabrication in the same industry. The Census of Manufactures in segregating products by industries, in classifying industries by major industrial groups and in reporting value added data in conformity with its grouping system, has made it convenient to adhere to its scheme of classification in assigning weights. Our series are then arranged by industries and by major groups in accordance with census classification. The assigned value added for each group is distributed among the industries representing the group in proportion to their actual respective value added as reported by the census. In turn the distributed value added for each industry is reapportioned among the constituent series representing products in proportion to the reported value added by manufacture for the respective product, or where such data are not available, in proportion to the value of the product. The final assignment of value added figures to groups, industries and products, is determined by a careful analysis of the underlying data included under each; of their trustworthiness as to source, of their general representativeness with respect to the group which the component series are designated to portray; of the extent to which they measure the changes in industries of the same group for which data are wanting; of the degree of accuracy with which they register the respective movements of the industries and of the products which they are especially designed to represent.

Weight factors may now be computed by dividing the value added figures assigned to a series for a given year by the respective quantity figures for the same year.[1]

It should be pointed out that an index of production based on weights derived from value added figures of a given year will register accurately the physical volume of production for a series of dates only on the assumption that there is throughout the period covered, no shift in the demand for the products and no change in the degree of elaboration in the various industries included in the index. An examination of our underlying data shows that there have been marked shifts in the demand for certain goods, or what is the same thing, in the relative importance of certain industries. As various industries and products change in relative importance in the course of time, so do the corresponding value added data, but while the value added and the correlative industry may usually vary together, they may not vary rela-

[1] This method of deriving weight factors for a production index was employed by the Federal Reserve Board in 1927. For an illustration of the process, see *Federal Reserve Bulletin*, March, 1927, Vol. XIII, p. 174.

tively in the same direction. Thus an industry and the related value added may decline together but the value added per unit of product may actually be increasing, or vice versa, they may rise together but the value added to each unit of product may be falling. If rising value added per unit could be taken as an indication of increasing elaboration and declining value added per unit as decreasing fabrication,[1] then surely these changes should be considered as important elements in the productive process as are those in the physical quantities.

During the period of years covered by our indexes, 1919 to 1929, the biennial Census of Manufactures has published five reports, showing figures of "value added by manufacture" for the census years 1919, 1921, 1923, 1925 and 1927. Analysis of the data discloses the fact that those of 1919, 1923, 1925 and 1927 are suitable for weighting purposes. The year 1921 experienced such a severe depression that both its quantity and value added figures are considered, because of their abnormal behavior, inappropriate as a basis for the computation of weights. In accordance with the procedure already described, the value added figures are allocated among the groups, industries and series, and four sets of weight factors are computed. The greatest changes in the weight factors appear, as may be expected, between the census years 1919 and 1923, during which period the value added per unit rose unprecedentedly in some industries and dropped precipi-

[1] A declining industry with a rising value added per unit of production may not signify higher manufacture of basic materials; it may merely reflect the fact that the industry is one which has been obeying the law of increasing returns, but which, because of a severe fall in the demand for its products has actually augmented its cost of production relative to the degree of fabrication. On the other hand, a rising industry accompanied by a declining value added per unit of production need not denote decreasing fabrication; it may be that as a result of the increasing use of machinery and labor saving devices, the cost of manufacturing is really lowered, while at the same time the quality of the product is actually improved. The motor car industry is a case in point. The quality of automobiles has steadily been improved, but the value added to each car relative to its quality has been considerably lowered.

This latter observation brings into view an interesting point regarding the effect of the change in efficiency of one industry as compared with another on a production index whose weights are based upon value added data. An index weighted by value added will not depart from the underlying aggregate of physical quantities so long as the period for which the index is constructed is a fairly short and stable one, in which there has been no radical change in the efficiency of one industry as compared with the others. Where, with the passage of time, great changes have occurred in an industry, the value added per unit of production in an early period is no longer comparable to that of a later period after the changes have taken place, for the latter represents the output of more utilities per unit of value than the former. When fundamental shifts in efficiency have arisen in some industries and not in others, or have arisen to a greater extent in some than in others, when the productive contribution in terms of utilities as measured by value added per unit of production would be greater per value unit in those industries in which changes in efficiency have occurred, or have occurred at a relatively more rapid rate as compared with those industries whose efficiency has remained constant or has changed at a relatively slower rate, then value added no longer measures the relative productive contribution of the several industries, at least, the value added as a measure of the output of utilities of the several industries at one period is no longer comparable with that of another period in which the shifts in efficiency have eventuated. The bearing of this analysis is clear. In a period in which violent shifts in efficiency among the industries have occurred, a variable system of weights, while it may correct the shifts in the relative importance of the component industries in the index, is not a satisfactory remedy for shifts in their relative efficiency. Comparisons, therefore, of the successive magnitudes of the production index must necessarily be uncertain in such a case.

tately in others. As between the census years 1923, 1925 and 1927, the changes in the weight factors are relatively less marked, but are nevertheless too important to be overlooked.

To test the effects of the different sets of weights, four annual indexes of producers' goods, of consumers' goods and of manufactures (the latter being a combination of the other two) are computed by using the four sets of weight factors. The results for the production of manufactures are presented in Table I. It is interesting to note that the greatest variations occur in the initial and terminal years. In 1919

TABLE I

ANNUAL INDEXES OF THE VOLUME OF MANUFACTURES
1923–1925=100

Year	Computed from					
	1919 Weights (1)	1923 Weights (2)	1925 Weights (3)	1927 Weights (4)	1923–1925–1927 Weights (5)	Geometric average of indexes computed from 1923, 1925, 1927 weights (Cols. 2, 3 and 4) (6)
1919.....	83.4	86.4	87.2	85.5	86.2	86.4
1920.....	86.8	88.8	89.4	88.6	88.9	88.9
1921.....	65.3	67.6	68.1	67.1	67.5	67.6
1922.....	85.9	87.3	87.5	87.2	87.3	87.3
1923.....	100.7	100.9	101.1	101.4	101.1	101.1
1924.....	93.9	94.2	94.3	94.2	94.2	94.2
1925.....	105.3	105.0	104.6	104.4	104.7	104.7
1926.....	108.8	108.3	107.8	107.4	107.8	107.8
1927.....	106.3	106.6	105.9	105.1	105.8	105.9
1928.....	112.9	112.1	111.6	110.8	111.5	111.5
1929.....	120.9	119.1	118.7	117.7	118.5	118.5

they vary from 83 with 1919 weights to 87 with 1925 weights, and in 1929 from 121 with 1919 weights to 118 with 1927 weights. Moreover, the greatest differences in the indexes are found to be between 1919 weights and the other more recent sets of weights. The dissimilarities in the indexes obtained from the 1923, 1925 and 1927 weights are relatively less pronounced, but it should be observed that beginning in 1925 the three indexes commence to spread apart, with the 1923 and 1925 weights consistently above the 1927. The effect of the different systems of weights on our index may thus be summarized: The use of weights derived from data of a date more remote from the present has the tendency of an upward "bias" toward the terminal of the period, or what is the same thing, the use of weights computed from data of a date less removed from the present has the effect of a downward "bias" toward the end of the period. It is interesting to note that so far as the base period, 1923–1925, is concerned, the differences between the indexes are so slight that it does not matter what system of weights is

used. The close agreement between the indexes at the base period and between those immediately preceding and following it, must largely be ascribed to the characteristic of the base to diminish the dispersion between the individual series of the respective indexes. In general these several observations made from a comparison of the indexes of manufactures apply to the indexes of producers' goods and of consumers' goods.

The differences in the indexes, resulting from the employment of different sets of weights, illustrate the necessity of adjusting the weights so as to secure results which will be more representative throughout the entire period. The relatively narrow range, within which the annual indexes computed with 1923, 1925 and 1927 weights vary, suggests the averaging of these three systems of weights to obtain a new set of weight factors. This, of course, permits us to retain the use of the aggregative formula. As pointed out by Professor Persons, the best index number of quantities for an intercomparison of three or more periods is given by this method.[1] To obviate the necessity of averaging averages, it is deemed more feasible to derive the new weight factors by aggregating the value added assigned to each series for 1923, 1925 and 1927, and then dividing this aggregate by the aggregate of the respective quantities for the three years. In columns 5 and 6 of Table I an annual index of manufactures, constructed with the new set of weight factors, together with a similar index obtained by taking the geometric average of the three indexes computed separately with weight factors of 1923, 1925 and 1927, is presented. It will be seen that the two are practically identical. The wide divergence between the indexes constructed with 1919 census data and those computed from 1923–1925–1927 census data, observed at the beginning and at the end of the interval, makes evident the fact that, if the later indexes may be taken to be more typical of the recent years, then surely they are not strictly typical of the earlier years. Some compromise must be effected which will make the indexes constructed with 1923–1925–1927 weights more representative of the earlier as well as the more recent years. The method adopted is the geometric average of each two sets of index numbers of those earlier overlapping years, in which the divergence occurs.[2] A study of the basic data of that period discloses the fact that for producers' goods and for manufactures, the

[1] W. M. Persons, "The Effect of Correlation between Weights and Relatives in the Construction of Index Numbers," *Review of Economic Statistics*, May, 1928, Vol. X, p. 107.

[2] This method, with slight variation, was used by W. Thomas in constructing the index of the production of manufactures of the Federal Reserve Board and by Perry and Silverman in computing an index of the physical volume of Canadian Business. W. Thomas, "Construction of an Index Number of Production," this JOURNAL, September, 1927, Vol. XXII, p. 325; Perry and Silverman, this JOURNAL, June, 1929, Vol. XXIV, pp. 137ff.

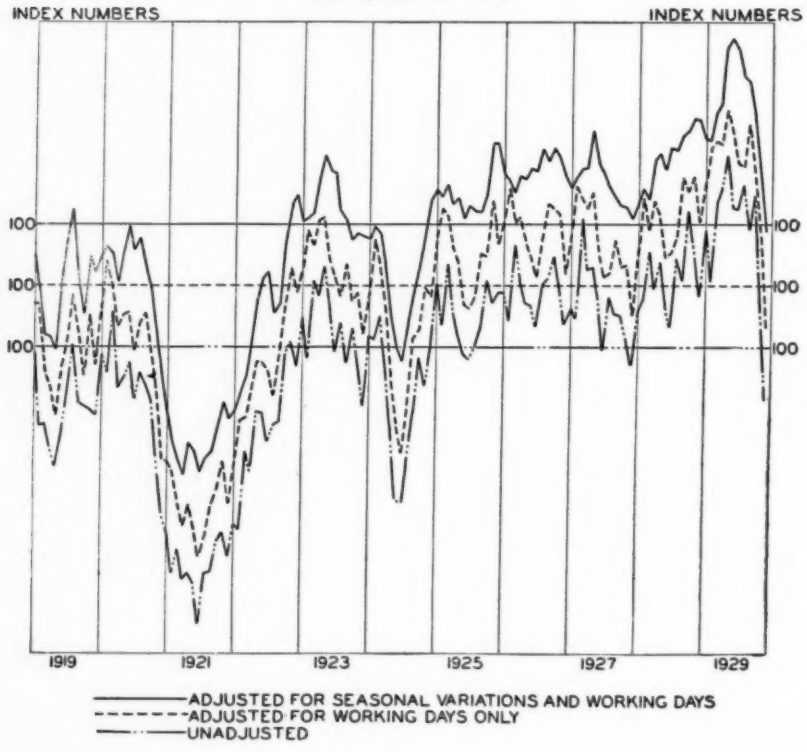
1919 weights going backward from 1921 are progressively more important than the 1923–1925–1927 weights, and for consumers' goods, the 1919 weights and the 1923–1925–1927 weights are considered to be of equal importance from 1919 to 1922. Accordingly, for producers' goods and manufactures, the index numbers with 1919 weights are taken in 1919 as thrice as, in 1920 as twice as, and in 1921 as equally important as those with 1923–1925–1927 weights; for consumers' goods, the simple geometric average of the two sets of index numbers is computed for the period, 1919–1922. For producers' goods and for manufactures from 1922 on, and for consumers' goods from 1923 on, only the 1923–1925–1927 weight factors are employed. This in brief, is the system of weights which is finally adopted for the computation of the monthly indexes.

The period 1923–1925 is selected as the base for comparison. The choice is made because of the overwhelming tendency on the part of

CHART III

INDEX OF PRODUCERS' GOODS: ADJUSTED FOR SEASONAL VARIATIONS AND WORKING DAYS, ADJUSTED FOR WORKING DAYS ONLY AND UNADJUSTED

(Average, 1923-25 = 100)



statisticians to take this period as the base for their index numbers. For comparative purposes, it is deemed desirable to have a base common to a large number of economic measurements.

Next the computed index numbers are subject to a correction to express them on the basis of average output per working day. For this purpose we have constructed a set of corrective factors, representing the number of working days for a given month, with which to divide into the index number for that particular month.[1] To illustrate the effect of the adjustments for the number of working days, both the adjusted and unadjusted indexes of producers' goods are shown on Chart III. The bottom curve, representing the unadjusted index, reveals the influence of the varying number of working days in the different months by the more erratic character of its month-to-month movements. A comparison of the adjusted indexes of the production of manufactures and of consumers' goods with the respective unadjusted indexes yields similar results.

The several indexes when adjusted for the number of working days are further corrected for seasonal variations.[2] The top curve on Chart III shows the effect of the seasonal adjustment on the index of the production of producers' goods.

Finally the indexes are adjusted for trend.[3]

[1] No attempt is made to correct each individual series for holidays To undertake such a task would entail an enormous amount of computation. Moreover, as the industries are located over wide areas, in which the uniform observance of holidays is unlikely, adjustments of individual industries become uncertain. In view of these considerations, we have constructed a set of generalized corrective factors for working days which exclude Sundays and certain holidays, among which are the following: January 1, February 22, Good Friday, May 30, July 4, Labor Day, Thanksgiving and Christmas. Independence Day, Labor Day, Thanksgiving and Christmas are allowed for as one day. January 1, February 22 and May 30 are counted as one day only when they fall on week days, and when they occur on Sundays, are taken as half day only. Good Friday is counted as half day.

[2] The following seasonal indexes used in adjusting the indexes are computed by the "ratio-to-trend" method:

Month	*Producers' goods*	*Consumers' goods*	*Manufactures*	*Consumers' goods excluding automobiles*
January	102.3	99.2	101.5	100.6
February	107.8	103.7	106.9	103.7
March	104.6	101.0	103.0	99.4
April	102.9	101.7	101.9	99.6
May	99.8	104.4	101.1	102.3
June	95.9	104.0	98.8	102.4
July	93.4	99.2	96.0	98.2
August	96.1	98.1	96.0	96.6
September	102.6	102.1	102.2	100.8
October	99.9	99.2	100.0	100.3
November	100.4	97.1	99.4	100.9
December	94.3	90.3	93.2	95.2

[3] The trend lines are based on the annual averages of the monthly indexes from January, 1919, to December, 1929, and are fitted by the method of least squares, with the origin at 1924. The equations are as follows:

Producers' goods: $y = 98.11 + 3.58x$

Consumers' goods: $y = 96.59 + 4.45x - .1055x^2$

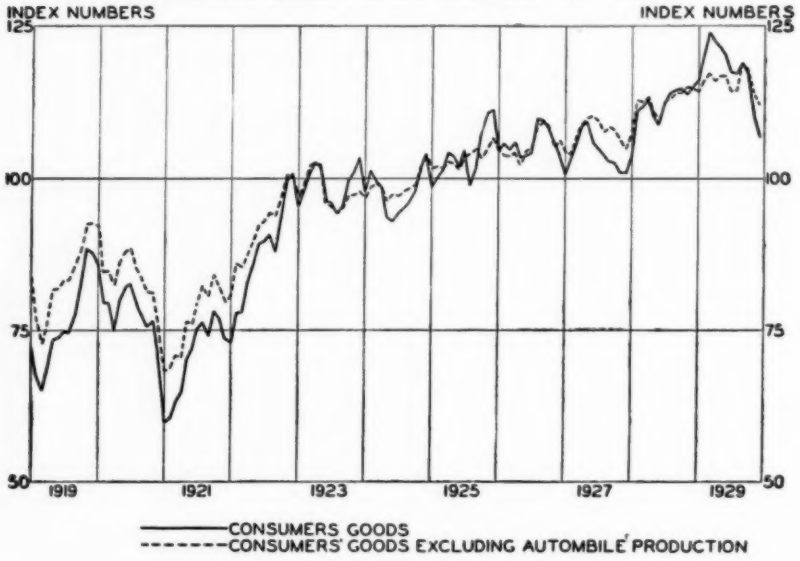
Manufactures: $y = 97.12 + 3.91x$

Consumers' goods excluding automobile production: $y = 97.87 + 3.73x$

CHART IV

COMPARISON OF THE INDEX OF CONSUMERS' GOODS WITH THE INDEX OF CONSUMERS' GOODS EXCLUDING AUTOMOBILE PRODUCTION

(Adjusted for Seasonal Variations—Average, 1923–1925 = 100)



Because of the importance of automobile production as a composite in the index of consumers' goods and of the greater amplitude of its fluctuations as compared with the other component series, it is of interest to compute a separate index of consumers' goods from which the automobile series is excluded. As may be seen from Chart IV, the trend is altered somewhat, but though the magnitude of the variations is modified, particularly that of the more recent period when automobile production has become increasingly important, the timing of the variations remains substantially the same. This less inclusive index is also corrected for the number of working days, seasonal variations and trend.

Two sets of index numbers—one adjusted for the number of working days and seasonal variations and the other for the number of working days, seasonal variations and trend—of the physical volume of production of producers' goods, of consumers' goods, of manufactures and of consumers' goods excluding automobile production are presented in the appendix.

The monthly ordinates are obtained by straight-line interpolation.

The adjustment is made by dividing the index number for each month corrected for seasonal variation by the corresponding trend value. The final result is equal to:

$$\frac{\text{Index number per working day}}{\text{Trend} \times \text{seasonal index}}.$$

APPENDIX

INDEX OF PRODUCTION OF PRODUCERS' GOODS

(Adjusted for Seasonal Variations. 1923–1925 average=100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual average
1919	95.0	89.7	82.0	81.2	79.1	90.7	97.1	102.5	90.4	85.5	94.9	92.4	90.0
1920	94.8	96.4	95.4	90.6	95.3	99.7	95.8	97.7	93.1	89.5	82.3	75.7	92.2
1921	69.7	64.7	61.6	59.1	64.3	62.8	59.6	61.7	62.8	66.9	70.9	68.2	64.4
1922	69.6	72.1	75.0	80.6	87.7	91.1	92.2	85.5	87.1	97.1	102.4	104.8	87.1
1923	100.5	101.0	101.8	107.4	111.3	108.7	108.4	102.2	100.8	97.5	98.5	97.9	103.0
1924	97.6	99.6	98.4	93.6	85.2	80.2	77.7	83.7	89.0	92.9	99.2	104.0	91.8
1925	105.8	104.4	106.4	103.2	104.2	101.0	103.0	102.1	102.4	104.8	113.3	113.3	105.3
1926	108.4	107.3	105.3	108.0	107.5	109.2	108.7	112.3	110.4	112.6	111.1	108.2	109.1
1927	106.1	107.8	109.2	109.3	115.4	110.0	108.6	106.3	104.7	103.1	102.8	101.0	107.0
1928	103.6	105.9	104.3	110.6	111.8	109.1	112.7	112.3	114.6	115.4	117.4	117.1	111.2
1929	114.2	113.7	118.2	119.7	129.0	130.3	128.6	124.3	123.3	118.0	107.3	98.9	118.8

(Adjusted for Seasonal Variations and Trend. Normal=100)

1919	120.9	113.7	103.6	102.2	99.1	113.3	120.9	127.1	111.6	105.2	116.4	112.8	112.2
1920	115.4	116.9	115.3	109.0	114.3	119.2	114.1	116.0	110.1	105.5	96.6	88.7	110.1
1921	81.3	75.1	71.3	68.2	74.0	71.9	68.1	70.2	71.2	75.7	80.0	76.6	73.6
1922	77.9	80.4	83.4	89.3	96.9	100.4	101.2	93.5	95.0	105.5	111.0	113.1	95.6
1923	108.2	108.4	108.9	114.5	118.3	115.1	114.5	107.6	105.8	102.0	102.8	101.8	109.0
1924	101.2	103.0	101.3	96.1	87.2	81.9	79.1	84.9	90.1	93.7	99.8	104.2	93.5
1925	105.7	104.0	105.7	102.2	102.9	99.5	101.2	99.9	100.0	102.0	110.1	109.7	103.6
1926	104.6	103.2	101.0	103.3	102.6	103.9	103.1	106.2	104.2	105.9	104.2	101.2	103.6
1927	98.9	100.3	101.2	101.2	106.5	101.3	99.6	97.3	95.5	93.8	93.3	91.4	98.4
1928	93.5	95.4	93.7	99.0	99.9	97.2	100.1	99.5	101.3	101.7	103.2	102.7	98.9
1929	99.8	99.2	102.8	103.9	111.6	112.5	110.7	106.8	105.7	100.8	91.4	84.1	102.4

INDEX OF PRODUCTION OF CONSUMERS' GOODS

(Adjusted for Seasonal Variations. 1923–1925 Average=100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual average
1919	72.1	67.5	65.0	68.8	73.4	73.7	74.7	74.5	77.4	82.1	88.3	87.6	75.4
1920	85.9	79.4	79.4	75.0	79.9	82.0	82.6	79.4	77.5	75.5	76.4	71.2	78.7
1921	59.9	60.5	63.2	64.6	70.1	71.8	75.0	76.2	74.1	78.1	76.7	73.6	70.3
1922	73.0	77.6	78.0	82.8	85.5	89.1	89.6	90.7	87.8	93.3	99.6	101.0	87.3
1923	95.4	98.1	101.0	102.6	101.8	96.2	96.0	94.2	95.5	99.7	101.3	103.5	98.8
1924	98.1	101.3	99.8	98.6	93.5	92.8	94.1	95.0	96.1	97.8	101.9	103.8	97.7
1925	98.7	100.1	101.2	104.2	103.6	102.0	104.6	98.9	101.8	107.6	110.8	111.2	103.7
1926	104.9	105.7	104.9	105.9	103.4	103.7	104.2	109.9	109.6	108.4	106.0	103.7	105.9
1927	100.8	102.9	105.8	108.5	109.2	105.9	105.0	103.9	102.9	102.6	101.0	101.0	104.1
1928	103.8	111.0	111.7	112.7	110.1	108.8	112.3	114.0	114.5	114.7	113.7	115.0	111.9
1929	116.0	120.3	123.5	122.4	121.6	120.0	117.3	117.1	118.9	117.0	110.4	106.9	117.6

(Adjusted for Seasonal Variations and Trend. Normal=100)

1919	104.2	97.0	92.9	97.5	103.4	103.1	103.8	103.0	106.3	112.0	119.7	118.1	105.1
1920	115.1	105.7	105.1	98.7	104.5	106.7	106.8	102.1	99.1	96.1	96.7	89.6	102.2
1921	74.9	75.2	78.2	79.5	85.9	87.5	90.9	91.9	88.9	93.2	91.1	87.0	85.3
1922	85.9	90.9	90.9	96.0	98.8	102.4	102.4	103.3	99.4	105.2	111.8	113.0	100.0
1923	106.1	108.7	111.4	112.7	111.4	104.8	104.0	101.7	102.7	106.8	108.1	110.0	107.4
1924	103.8	106.8	104.8	103.1	97.3	96.2	97.2	97.9	98.5	99.9	103.7	105.2	101.2
1925	99.7	100.8	101.5	104.2	103.3	101.2	103.5	97.5	100.0	105.3	108.1	108.1	102.8
1926	101.7	102.1	101.0	101.6	98.9	98.9	99.1	104.1	103.5	102.0	99.5	97.0	100.8
1927	94.1	95.7	98.1	100.3	100.7	97.3	96.3	94.9	93.8	93.2	91.6	91.3	95.6
1928	93.5	99.7	100.1	100.7	98.1	96.7	99.5	100.7	101.0	100.9	99.7	100.6	99.3
1929	101.2	104.6	107.2	106.0	105.0	103.4	100.9	100.4	101.8	99.9	94.0	90.8	101.3

INDEX OF PRODUCTION OF MANUFACTURES

(Adjusted for Seasonal Variations. 1923–1925 Average=100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual average
1919	86.2	81.3	76.2	77.1	77.0	83.9	87.8	92.7	85.6	83.7	92.1	89.9	84.4
1920	91.1	89.6	89.9	85.2	89.6	92.7	90.1	91.6	87.3	83.9	79.8	73.6	87.0
1921	66.0	63.0	62.2	61.3	66.8	66.3	65.1	67.7	67.0	70.7	72.8	69.8	66.6
1922	71.5	74.5	76.7	82.4	87.8	91.0	91.5	88.9	88.3	95.9	101.6	103.5	87.8
1923	98.2	99.3	101.7	106.1	107.8	103.8	103.0	99.9	99.0	97.9	99.3	99.6	101.3
1924	97.3	99.6	99.2	96.0	88.8	85.3	83.9	88.9	91.9	94.4	100.0	103.5	94.1
1925	102.8	102.1	104.7	104.1	104.4	101.6	103.1	101.7	102.3	105.5	112.2	111.9	104.7
1926	106.8	106.1	105.3	107.8	106.3	107.3	106.5	112.3	110.3	110.5	108.9	106.0	107.8
1927	103.7	105.2	108.2	109.6	113.5	108.6	106.7	106.4	104.2	102.5	101.8	100.4	105.9
1928	103.3	107.1	107.3	112.1	111.6	109.1	112.1	113.9	114.8	114.7	115.8	115.7	111.5
1929	114.5	115.4	120.4	121.4	126.5	126.4	123.6	122.7	121.9	117.3	108.1	101.4	118.3

(Adjusted for Seasonal Variations and Trend. Normal=100)

1919	113.8	106.8	99.7	100.5	99.8	108.4	113.0	118.8	109.2	106.3	116.5	113.3	108.8
1920	114.4	112.0	111.9	105.6	110.7	114.0	110.3	111.7	106.1	101.5	96.2	88.4	106.9
1921	78.9	75.0	73.9	72.5	78.6	77.8	76.0	78.9	77.8	81.7	83.9	80.2	77.9
1922	81.8	84.8	87.0	93.1	98.9	102.1	102.2	99.0	97.9	106.0	112.0	113.6	98.2
1923	107.4	108.1	110.5	114.8	116.2	111.6	110.3	106.6	105.3	103.8	104.8	104.8	108.7
1924	102.1	104.1	103.4	99.6	91.9	88.0	86.1	91.0	93.8	96.1	101.4	104.7	96.8
1925	103.5	102.5	104.8	103.9	103.8	100.7	101.9	100.1	100.5	103.2	109.5	108.8	103.6
1926	103.5	102.5	101.5	103.4	101.8	102.4	101.3	106.5	104.3	104.1	102.3	99.4	102.7
1927	96.8	97.9	100.4	101.5	104.6	99.9	97.8	97.3	95.0	93.2	92.3	90.8	97.3
1928	93.0	96.3	96.1	100.1	99.4	96.9	99.3	100.5	101.1	100.7	101.3	101.0	98.8
1929	99.6	100.2	104.2	104.7	108.9	108.5	105.8	104.7	103.7	99.6	91.5	85.6	101.4

INDEX OF PRODUCTION OF CONSUMERS' GOODS

(Excluding Automobile Production)

(Adjusted for Seasonal Variations. 1923–1925 Average=100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual average
1919	83.8	76.6	72.9	76.2	81.6	81.9	83.1	83.2	85.5	87.9	92.5	92.6	83.1
1920	92.1	84.6	84.7	82.4	86.3	88.0	88.4	85.3	83.7	81.4	81.2	75.4	84.5
1921	68.3	68.6	70.7	70.1	76.2	76.0	79.5	82.1	80.5	84.1	81.9	79.4	76.4
1922	80.8	85.5	85.3	87.4	89.7	92.2	92.9	94.2	93.7	96.8	100.6	100.0	91.6
1923	97.1	98.8	102.1	102.5	102.3	95.9	95.5	94.1	95.0	97.1	97.3	97.8	98.0
1924	96.9	98.6	99.1	98.5	96.3	97.4	97.1	97.9	98.4	98.9	102.2	104.1	98.8
1925	101.7	101.9	101.7	102.6	102.4	101.5	103.5	104.0	104.8	103.4	104.9	106.6	103.2
1926	104.7	103.8	103.7	104.3	102.4	104.6	104.8	108.4	109.3	108.8	105.9	106.2	105.6
1927	104.3	104.0	106.9	108.9	109.9	110.1	109.5	107.7	108.4	107.8	106.4	105.0	107.4
1928	107.5	112.6	112.4	112.8	110.7	109.7	112.5	113.0	114.0	114.1	114.9	114.5	112.4
1929	114.2	115.8	117.2	116.0	116.7	116.7	114.3	114.4	118.7	117.9	114.1	112.4	115.7

(Adjusted for Seasonal Variations and Trend. Normal=100)

1919	108.2	98.4	93.4	97.1	103.6	103.6	104.7	104.5	106.9	109.5	114.7	114.5	104.9
1920	113.4	103.7	103.4	100.3	104.6	106.3	106.3	102.3	100.0	96.8	96.2	89.1	101.9
1921	80.3	80.4	82.6	81.5	88.5	87.8	91.5	94.2	92.0	95.8	93.0	88.9	88.0
1922	91.1	96.0	95.5	97.6	99.8	102.1	102.5	103.6	102.8	105.8	109.5	108.5	101.2
1923	105.1	106.6	109.8	109.7	109.3	102.1	101.3	99.5	100.1	102.0	101.9	102.0	104.1
1924	100.8	102.2	102.4	101.4	98.8	99.6	99.1	99.6	99.7	99.9	102.9	104.5	100.9
1925	101.8	101.7	101.2	101.7	101.3	100.0	101.6	102.0	102.3	100.7	101.8	103.2	101.6
1926	101.0	99.8	99.5	99.8	97.7	99.4	99.3	102.4	103.0	102.2	99.2	99.2	100.2
1927	97.1	96.5	99.0	100.6	101.2	101.1	100.2	98.2	98.7	97.8	96.3	94.9	98.5
1928	96.7	101.1	100.6	100.6	98.5	97.4	99.6	99.8	100.4	100.1	100.6	100.0	99.6
1929	99.5	100.6	101.5	100.2	100.6	100.3	97.9	97.7	101.1	100.3	96.7	95.1	99.3

DATA USED IN THE INDEX OF PRODUCERS' GOODS

Series	Assigned value added by manufacture in 1923–1925–1927 (in millions of dollars)	Percentage of individual item to total	Source
1. Mill consumption of raw cotton	5,405	13.8	Bureau of the Census
2. " " " " " wool	2,620	6.7	Ditto
3. Deliveries of raw silk to mills	2,200	5.6	Silk Association of America
4. Pig iron production	1,125	2.9	Iron age
5. Steel ingots production	12,660	32.2	American Iron and Steel Institute
6. Lumber production	5,055	12.9	Bureau of the Census and estimates
7. Oak and maple flooring production	700	1.8	Survey of Current Business
8. Sole leather production	285	.7	Bureau of the Census
9. Production of upper leather—cattle	180	.4	Ditto
10. Production of upper—calf and kid	200	.5	Ditto
11. Production of upper—coat and kid	300	.8	Ditto
12. Newsprint production	309	.8	Federal Trade Commission and Newsprint Service Bureau
13. Wrapping paper production	444	1.1	Federal Trade Commission, American Paper and Pulp Association and Survey of Current Business
14. Paper board production	584	1.5	Bureau of the Census
15. Mechanical pulp production	43	.1	Federal Trade Commission, American Paper and Pulp Association, Survey of Current Business
16. Chemical pulp production	135	.3	Ditto
17. Production of paper board shipping boxes	385	1.0	Paperboard Industries Association and Survey of Current Business
18. Fuel oil production	291	.7	Bureau of Mines
19. Lubricating oil production	156	.4	Ditto
20. By-product coke production	1,045	2.7	Ditto
21. Beehive-coke production	105	.3	Ditto
22. Cement production	990	2.5	Ditto
23. Plate glass production	640	1.6	Plate Glass Manufacturers of America
24. Blister copper production	1,285	3.3	American Bureau of Metal Statistics
25. Crude lead production	370	.9	Ditto
26. Slab zinc	500	1.3	American Zinc Institute
27. Tin deliveries	290	.7	New York Metal Exchange
28. Production of motor trucks	440	1.1	Bureau of the Census
29. Shipment of locomotives by manufacturers	110	.3	Ditto
30. Shipment of freight and passenger railway cars by manufacturers	285	.7	Interstate Commerce Commission
31. Vessels built	145	.4	Bureau of Navigation

DATA USED IN THE INDEX OF CONSUMERS' GOODS

Series	Assigned value added by manufacture in 1923–1925–1927 (in millions of dollars)	Percentage of individual item to total	Source
1. Hogs slaughtered under federal inspection	1,942	8.3	Bureau of Animal Industry
2. Cattle slaughtered under federal inspection	1,226	5.2	Ditto
3. Calves slaughtered under federal inspection	137	.6	Ditto
4. Sheep slaughtered under federal inspection	125	.5	Ditto
5. Wheat flour production	1,440	6.1	Russell's Commercial News
6. Rice shipments from mills	70	.3	Rice Millers' Association
7. Meltings of raw sugar	800	3.4	Statistical Sugar Trade Journal
8. Butter production	757	3.2	Bureau of Agricultural Economics
9. Cheese production	152	.7	Ditto
10. Production of condensed and evaporated milk	291	1.2	Ditto
11. Production of ice cream	680	2.9	Ditto
12. Corn grindings	320	1.4	Associate Corn Products Manufacturers
13. Production of oleomargarine	90	.4	Bureau of Internal Revenue
14. Percentage of carpet and rug loom hours active	645	2.7	Bureau of the Census
15. Production of underwear	1,005	4.3	Ditto
16. Shipment of enameled sanitary wares	505	2.1	Ditto
17. Production of boots and shoes	1,365	5.8	Ditto
18. Pneumatic tire production	1,065	4.5	Rubber Association of America
19. Inner tube production	180	.8	Ditto
20. Newsprint consumption	2,442	10.4	Federal Trade Commission and American Newspaper Publishers' Association
21. Book paper production	2,004	8.5	Ditto, and Survey of Current Business
22. Fine paper production	1,194	5.1	Ditto
23. Gasolene production	701	3.0	Bureau of Mines
24. Kerosene production	102	.4	Ditto
25. Crude cottonseed oil production	270	1.2	Bureau of the Census
26. Cigarettes—tax-paid withdrawals	485	2.1	Bureau of Internal Revenue
27. Cigars— " " "	290	1.2	Ditto
28. Chewing, smoking and snuff "	150	.6	Ditto
29. Passenger automobile production	3,070	13.1	Bureau of the Census

THE INADEQUACY OF CENSUS DATA FOR INDIVIDUAL INDUSTRIES

By Glenn E. McLaughlin, *Bureau of Business Research, University of Pittsburgh*

The United States Bureau of the Census is prohibited by law from publishing any statistics which may disclose even approximately the data supplied by individual establishments. This restriction compels the Bureau to combine in one item data for those industries which report only one or two plants or which are dominated by one or two corporations. Such combined items represent a complete loss in detail to the research student who is interested in the relative importance of different industries. The Bureau seldom finds it necessary to use such items in publishing data by industries for the United States as a whole but in presenting data for cities having 100,000 inhabitants or more a large number of industries are usually lumped together as "all other industries." For each of these industries no separate data are given relative to number of establishments, wage earners, wages, or value of products; for that matter, no list of the specific industries included in the combined item is published in any but decennial censuses.[1] The Bureau warns the research student that such items often include industries which are more important than some of those shown separately.

According to the practice of the Bureau of the Census, separate data for an industry—whether in a city, a state, or the United States—may not be published under the following circumstances: (1) when the industry contains less than three firms, (2) when one establishment or corporation produces 75 per cent of the total value of products, (3) when two establishments or corporations produce 90 per cent of the total value of products. Furthermore, (4) separate data for an industry *in a city* cannot be published, regardless of the number of establishments, when there are only one or two establishments or corporations, or only one dominating establishment or corporation, operating in the remainder of the state. In such cases only the state figures are published.

Of the four cases the first is by far the most common. All cities and indeed all states contain industries with only one or two establishments. For example, no data can be obtained for the shipbuilding industry in Philadelphia in 1919, 1921, or 1927 owing to the small number of plants. Data for the locomotive industry in New York State have not been available for several censuses. Occasionally these industries with less

[1] Lists of such industries for both states and cities were published for the biennial census of 1921.

than three establishments rank among the most important. The shipbuilding industry ranked high in Philadelphia in 1919.

The second case is not frequent, though it may result in withholding data for a few outstanding industries. Thus no data are given for steam-railroad repair shops in Connecticut, although in 1927 there were twelve establishments in this industry. No doubt this is due to the fact that 75 per cent of the activity is confined to shops of the New York, New Haven, and Hartford Railroad. Although there are more than three plants producing agricultural implements in Chicago and more than three producing aluminum manufactures in Pennsylvania, no data are available for either. Because of the varying importance of the largest establishment, it may be possible to present data for an industry in one year, but impossible in another. For example, in 1921 no data are available for the production of corn sirup, corn oil, and starch in Illinois whereas in 1927 data are given. In each year the industry included four establishments.

The third case is difficult to identify. Probably owing to the great relative importance of two corporations, data on the soap industry in Wisconsin are lacking in recent censuses; about ten plants have been in operation.

Although it is not a general restriction, several examples can be given of the fourth case, i.e., the impossibility of publishing data for an industry in a city because of the small number of establishments in the rest of the state. Chicago in particular has been affected. For that city it has usually been impossible to publish data for a number of industries owing to the fact that each included only two establishments in Illinois outside of Chicago. An example is the electroplating industry with 42 establishments in the city and 44 in the state. A comparable situation rarely precludes the publication of state figures. Yet in 1921 it was impossible to present Louisiana totals for the cane sugar industry, excluding the products of refineries, even though only two of the 134 establishments were located outside of that state. By 1927 it was possible to give the data for Louisiana since all of the 53 establishments then in operation were in that state.

In the summary for each industry it is often necessary that the data for several states be combined in an "other states" item. Because of the danger of disclosing data for individual establishments this combined item may include statistics for several states representing a sizable percentage of the total activity in an industry. For the cement industry in 1927, this item contains 36.5 per cent of all the wage earners in the industry. These were employed in 66 establishments scattered

as follows: Alabama 7, Colorado 3, Florida 1, Georgia 3, Illinois 5, Indiana 5, Kentucky 1, Louisiana 1, Maryland 2, Minnesota 3, Montana 2, Nebraska 1, New Jersey 2, Ohio 11, Oklahoma 2, Oregon 3, South Dakota 1, Utah 3, Virginia 2, Washington 4, West Virginia 3, Wisconsin 1.

TABLE I

PER CENT OF THE TOTAL NUMBER OF WAGE EARNERS FOR EACH OF SIXTY SELECTED INDUSTRIES REPORTED UNDER THE "OTHER STATES" CLASSIFICATION, UNITED STATES, 1927

	Per Cent		*Per Cent*
Agricultural implements	3.0	Knit goods	3.1
Artificial leather	52.0	Lard substitutes	52.8
Blast furnaces	6.6	Locomotives	100.0
Boots and shoes, not rubber	1.5	Lumber and timber products	0.1
Boots and shoes, rubber	55.0	Motor cycles, bicycles, and parts	46.6
Bread and bakery products	0.0	Motor vehicle bodies and parts	0.1
Canning and preserving: Vegetables, etc.	0.6	Motor vehicles	4.2
Car and general construction and repairs, steam railroad repair shops	1.3	Paper	1.7
Carpets and rugs, rag	37.8	Pens, steel and brass	100.0
Carpets and rugs, wool, not rag	11.1	Petroleum refining	10.6
Cars, electric and steam railroad	19.7	Plumbers' supplies	29.6
Cast-iron pipe	17.9	Pottery	4.9
Cement	36.5	Printing and publishing	0.0
Chemicals	6.5	Rubber goods other than shoes, tires and tubes	20.5
Cigars and cigarettes	5.9	Rubber tires and inner tubes	18.4
Clothing, men's, except work clothing	0.7	Sand-lime brick	62.9
Clothing, women's	0.7	Ship and boat building	5.2
Collars, men's	6.3	Silk manufactures	5.4
Cotton goods	0.8	Slaughtering and meat packing	3.8
Cutlery and edge tools	8.9	Smelting and refining, copper	56.0
Electrical machinery	0.8	Smelting and refining, lead	70.7
Flax and hemp, dressed	42.8	Soap	22.7
Food preparations	10.4	Steel works and rolling mills	8.8
Forgings, iron and steel	1.8	Structural and ornamental iron and steel work	0.8
Foundry and machine shop products	0.0	Sugar, beet	63.5
Gas and electric fixtures	7.9	Sugar refining, cane	40.8
Glass	6.5	Textile machinery	7.7
Gloves and mittens, leather	9.8	Whips	100.0
Graphite, ground and refined	100.0	Woolen goods	2.4
Grindstones	5.8	Worsted goods	6.7

As a rule the loss in detail is not as great as it was in the cement industry in 1927. This is clear from the percentages for 60 selected industries presented in Table I. The loss in detail tends to vary with the size of the industry. The large industries show little loss in detail whereas some of the smallest show no detail at all. But this is by no means a complete relationship. A great deal depends on whether the industry is concentrated in a few states. There is practically no loss in data for those industries which are distributed over the country in proportion to the population—generally industries which rank high for the country as a whole. No loss occurs, for instance, in the printing or in the baking industries. The loss in detail is much greater in many of the industries characterized by large scale production, as in the rubber industry, in smelting and refining, and in many branches of the steel industry. In highly concentrated industries, data may be quite com-

TABLE II

PER CENT OF THE TOTAL NUMBER OF WAGE EARNERS REPORTED UNDER THE "ALL OTHER INDUSTRIES" CLASSIFICATION, FOR EACH CITY, 1927

	Per Cent		*Per Cent*		*Per Cent*
Akron, Ohio	5.7	Grand Rapids, Mich.	19.4	Providence, R. I.	46.8
Albany, N. Y.	64.7	Hartford, Conn.	68.6	Reading, Pa.	39.4
Allentown, Pa.	38.4	Houston, Tex.	48.8	Richmond, Va.	32.4
Atlanta, Ga.	57.7	Indianapolis, Ind.	36.0	Rochester, N. Y.	32.0
Baltimore, Md.	24.5	Jacksonville, Fla.	63.0	St. Louis, Mo.	27.3
Bayonne, N. J.	93.9	Jersey City, N. J.	52.8	St. Paul, Minn.	35.6
Birmingham, Ala.	28.1	Kansas City, Kans.	22.6	Salt Lake City, Utah	61.7
Boston, Mass.	14.4	Kansas City, Mo.	22.6	San Antonio, Tex.	46.1
Bridgeport, Conn.	46.7	Knoxville, Tenn.	45.2	San Diego, Calif.	37.4
Buffalo, N. Y.	26.2	Los Angeles, Calif.	12.9	San Francisco, Calif.	29.9
Cambridge, Mass.	46.9	Louisville, Ky.	57.7	Savannah, Ga.	78.3
Camden, N. J.	82.8	Lowell, Mass.	37.5	Schenectady, N. Y.	97.2
Canton, Ohio	87.0	Lynn, Mass.	50.0	Scranton, Pa.	43.9
Chicago, Ill.	12.8	Memphis, Tenn.	55.2	Seattle, Wash.	28.5
Cincinnati, Ohio	17.1	Miami, Fla.	30.7	Somerville, Mass.	46.4
Cleveland, Ohio	12.6	Milwaukee, Wis.	26.2	Spokane, Wash.	44.5
Columbus, Ohio	22.8	Minneapolis, Minn.	28.1	Springfield, Mass.	75.5
Dallas, Tex.	31.0	Nashville, Tenn.	53.0	Syracuse, N. Y.	54.6
Dayton, Ohio	56.0	Newark, N. J.	19.2	Tacoma, Wash.	33.5
Denver, Colo.	33.6	New Bedford, Conn.	9.6	Tampa, Fla.	14.7
Des Moines, Iowa	53.5	New Haven, Conn.	59.1	Toledo, Ohio	61.1
Detroit, Mich.	15.4	New Orleans, La.	39.7	Trenton, N. J.	52.7
Duluth, Minn.	67.7	New York, N. Y.	4.6	Tulsa, Okla.	33.2
Elizabeth, N. J.	74.1	Norfolk, Va.	62.1	Utica, N. Y.	57.5
El Paso, Tex.	40.2	Oakland, Calif.	45.9	Washington, D. C.	31.8
Erie, Pa.	54.4	Oklahoma City, Okla.	41.9	Waterbury, Conn.	44.9
Evansville, Ind.	69.3	Omaha, Nebr.	68.4	Wichita, Kans.	60.6
Fall River, Mass.	14.2	Paterson, N. J.	13.3	Wilmington, Del.	71.6
Flint, Mich.	100.0	Philadelphia, Pa.	12.4	Worcester, Mass.	49.7
Ft. Wayne, Ind.	76.2	Pittsburgh, Pa.	23.3	Yonkers, N. Y.	93.4
Ft. Worth, Tex.	54.3	Portland, Ore.	32.2	Youngstown, Ohio	37.7

plete. New York employs 93.7 per cent of all wage earners in the men's collar industry. Consequently the loss in data is only 6.3 per cent. The same is true of the production of grindstones, 94.2 per cent of all wage earners in this industry working in Ohio and West Virginia.

In no city are data completely itemized by industries. The loss in detail for the number of wage earners in 1927 varied from 4.6 per cent for New York City to 100.0 per cent for Flint, Michigan. The average loss is high, much higher than in the case of statistics for individual industries for the country as a whole. Table II presents percentages of the number of wage earners placed in "all other industries" for the 93 cities for which detailed data were published in the Biennial Census of Manufactures in 1927. There is a certain inverse relationship between the total number of wage earners employed in a city and the size of the "all other" item, the coefficient of rank correlation being -0.50.

Cities specializing in one or two industries show either a small or a great loss of detail in data. Thus the percentage of total wage earners in "all other industries" is low for New Bedford, Akron, and Paterson but very high for Flint, Schenectady, and Bayonne. In the latter three cities the specialization is accounted for by one or two corporations.

Even in state statistics there are great losses in detail, though these

are not as large as the losses for cities. The residue item is of the least importance in New York and Pennsylvania, and in 1927 in only one of the outstanding industrial states—Connecticut—did it amount to more than 10 per cent of the total. The greatest losses occurred in Delaware, South Dakota, and Colorado. Of the total number of wage earners in 1927 in Delaware 45.7 per cent were lumped in the all other classification. A coefficient of rank correlation of −0.55 indicates a certain inverse relationship between the total number of wage earners employed in manufacturing in a state and the loss of detail.

Such gaps in data may be very distressing to the research worker. In an attempt to present a complete study it is often necessary to spend considerable time in making estimates, some of which are likely to deviate materially from the correct figures. More complete data would be of value in almost any study based upon the statistics of the Bureau of the Census. Studies in industrial migration, in the localization of particular industries, in tendencies away from or toward greater dispersion, or simply in the trends in individual industries or groups of industries within a given city or state—all of these could profitably use more detailed data. It is very difficult to analyze the industrial structure of a city—for example, to measure the relative concentration —unless statistics for each industry are available.

The first data on manufacturing collected by the Federal Government from the different states were published in detail, regardless of the number of plants in each industry. Complete information concerning quantity or value of output, cost of materials, wages, and number of employees was presented as a result of the first census of manufactures in 1810. The same was true of the next census, taken in 1840, and of each decennial census thereafter until 1890, although in the census of 1880 some summary tables included unimportant industries in an "all other industries" item and others included the lesser producing states in an "all other states" item. This, however, is a very different procedure from that adopted in the census of 1890 whereby the identity of individual plants was hidden.[1]

The earlier censuses not only published completely detailed data but often went behind the state or county totals and gave information concerning the more significant producers. For example, the census of 1860 in referring to one of the two steel furnaces in New York said, "The Damascus Steel and Iron Company, on Staten Island, with a capital of $200,000 and 90 hands, made 800 tons of rolled steel, worth

[1] The practise of hiding the identity of individual plants was introduced in order that the Bureau of the Census might require figures from certain corporations which had refused to make reports on the grounds that census publication might reveal the conditions of their businesses.

$160,000 and 400 tons of hammered steel, valued at $112,000; total, 1,200 tons, worth $272,000. The materials consumed in the production of this amount were 1,300 tons of bar-iron, costing $84,000; 6,000 tons of coal, worth $27,000; and other materials valued at $23,000; a total of $134,000."

Detailed statistics are not now published by the Bureau of the Census because of legal restrictions forbidding the publication of any data which might reveal even approximately the data supplied by individual plants or corporations. All answers to census questionnaires must be "held in strict confidence." Presumably the purpose of this secrecy is to keep even the approximate figures of a corporation from the inquiring eyes of a competitor. But of all individuals the competitor is the most likely to know these figures. He does not need census data in order to reach a fairly accurate estimate of another producer's employment or production. It may be that several producers through trade associations or informal conferences are exchanging this information, perhaps even on a monthly, instead of a biennial, basis. In any event it is quite likely that present restrictions placed upon the Bureau of the Census handicap the research student more than they insure the secrecy of production figures.

Such generally known data as the number of wage earners might well be published biennially for each industry regardless of the number of plants without seriously violating the secrecy of an individual plant's operation, especially when it is noted that census data for states or cities have so far not been published until the second year after the period covered. The remaining data—wages, costs of materials, and value of production—might properly be made available to the interested research student or economic historian after a period of, say, ten years. Surely by that time the figures have lost their competitive significance.

Yet even present restrictions do not prohibit the publication of tables listing the industries represented in the "all other" group together with the number of plants in each; these tables are given in decennial censuses. They were also published in the biennial census of 1921. Nor do legal restrictions preclude the publication of tables showing the location and number of establishments by counties. Paul W. Stewart of the Department of Commerce included this material for 1927 in his *Market Data Handbook of the United States.*

Of the remaining categories of data the least secret is probably the average number of wage earners. Locally the employment of a plant may be accurately known; though if the plant be one of two in the industry or the dominating one of several it is impossible to tell from the

most complete statistics now published by the Bureau whether the industry represented is of great or little importance. Some states publish directories giving employment figures of all manufacturing establishments. Such is the case in Pennsylvania where the directory classifies firms according to industry and according to city and county, so that it is possible to determine the relative importance of any industry in any city or county. The average number of wage earners employed in a given plant or by a given corporation has not been considered confidential information. Indeed, prior to 1922 Pennsylvania published complete industrial statistics—including data on wages, value of product, and so forth—for each industry represented in a city or county regardless of the number of establishments.

Below are given, in the order of desirability, alternative suggestions for increasing the adequacy of census data. First is listed the initial publication of complete data; the other suggestions are substitutes for the first, each calling for less and less additional data until the last suggestion which calls for the release after a period of years of data covering the number of wage earners in every industry. (The Bureau of the Census at the present time will release detailed data for industrial *groups*, at least in the case of states and large cities.) It is desirable, however, that additions to census data be made gradually. If the Bureau of the Census is successful in securing the coöperation of manufacturers in collecting and presenting data for the number of wage earners in the individual industries represented in each state and in each city, the presentation of more complete data might well be considered. The following suggestions apply to data for the United States, for individual states, and for individual cities:

1. Original publication of detailed data for every industry, i.e., data covering number of establishments, number of wage earners, wages, cost of materials, value of products, and, for bulk products, quantities. From value of products and cost of materials the value added by manufacture can be calculated.
2. Original publication of data covering the number of wage earners and value added by manufacture in every industry and the release after a period of years of the remaining data.
3. Original publication of data covering the number of wage earners in every industry and the release after a period of years of the remaining data.
4. Original publication of detailed data for every industrial group (foods, textiles, etc.) and the release after a period of years of detailed data for every industry.
5. The release after a period of years of detailed data for every industry.

6. The release after a period of years of data covering the number of wage earners in every industry.

At present it is probably impossible to secure legal authorization[1] for the publication of wage or production statistics for industries regardless of the number of plants. On the other hand, the chance of securing permission to publish figures for the average number of wage earners for each industry is undoubtedly greater. The number of wage earners in most cases gives a reasonably accurate indication of the relative importance of an industry. Even if legal permission to publish these data is obtained, it may be urged that the expense of compiling and publishing the data would be great. As a matter of fact the Bureau of the Census at present makes such calculations and the space for publication would require not more than 50 additional pages in the present biennial volume of 1500 pages. Perhaps the data could be placed in footnotes. It is believed that the desirability of this material is well worth the expense which its presentation would entail.

It must be added that two important changes are being made in the Census of Manufactures for 1929: in the first place primary emphasis is being placed on the presentation of data for industrial regions—corresponding data for the major city being given only when it is possible to release both—and in the second place the "all other industries" figures are being broken down into figures for industrial groups or combinations of groups when necessary.[2] The first change will allow the publication of figures for an industry where there are enough establishments in the city and immediately outside to make up industrial totals which reveal the identity of no separate establishment, provided that the figures for the area and those for the state do not reveal the identity of establishments in the remainder of the state. There will remain, however, in most regions industries, often of major size, for which no data can be given because of the small number of establishments or because of the dominating importance of one or two. The second change will result in the publication of data very valuable in the analysis of the industrial structure of a city or region, but in any given instance an industrial group may include many particular industries and perhaps several of major importance. For the thorough analysis of the manufacturing activity of a region or a city it still remains necessary to secure some indication of the relative importance of each industry.

[1] In the opinion of the officials in the Bureau of the Census to whom this article by Mr. McLaughlin was referred, it would be impracticable to put into effect any of the six suggestions specified in his paper, with the possible exception of No. 6 and the first part of No. 3; and even that it is believed could not be done without securing legal authorization and the consent of the manufacturers concerned.—Ed.

[2] The Bureau will discontinue publishing statistics by industries for a region unless separate figures for the leading industry can be published or unless those industries for which figures can be presented account for at least 50 per cent of the total number of wage earners.

ECONOMIC FACTORS IN NEGRO MIGRATION

By Edward E. Lewis, *Howard University*

Among the causes of the recent movement of Negroes from southern farms to the industrial centers of the country, are two of an economic character, namely, the demand for labor on the part of industry, and the recent agricultural disorganization in the Cotton Belt. A straightforward statistical analysis of the "industrial" and "agricultural" factors in Negro migration would involve the correlation of an index of migration (from the various counties of the Cotton Belt) with indexes of the two underlying factors.[1] Such a procedure cannot be followed, however, because it is impossible to measure directly the strength of industrial labor demand or the repulsive force of agricultural depression.[2] It is necessary, therefore, to proceed by indirection.

While there is no quantitative information concerning the causal factors in which we are interested, extensive data are available concerning three distinct phenomena into which these factors enter, namely, Negro migration, white migration, and changes in the amount of cotton cultivated in the various parts of the Cotton Belt.[3] (This third phenomenon is affected not only by the profitableness of agriculture, that is, by the agricultural factor, but also by the industrial factor, causing shortage or abundance of agricultural workers.) It is by a study of these three "resultant" phenomena that the importance of the underlying factors in one of them—Negro migration—is estimated.

The relations obtaining among the two underlying factors and the three resultant phenomena may be expressed in terms of mathematical symbols. Let A and I represent the agricultural and industrial

[1] For a discussion of the problems raised by the utilization of these rather broad sets of conditions as single factors, see E. E. Lewis, *The Mobility of the Negro*, pp. 13–16.

[2] For the most part, during the period studied, agricultural conditions were such as to cause migration out of rural territory. It is necessary to recognize, however, that in some instances relatively favorable agricultural conditions attracted Negroes back to the farm. In other words the agricultural factor must be interpreted as having both positive and negative values. The same interpretation is necessary for the industrial factor, that is, as drawing Negroes into industry, or through urban unemployment forcing them back to the country.

[3] The three sets of information consist of percentage changes from 1919 to 1924, in the number of colored farmers (figures for the total agricultural population are not available, but the "farmers," because they include "croppers" and therefore a large proportion of all agricultural workers, give an adequate index of the total agricultural population), percentage changes in the number of white farmers, and percentage changes in the cotton acreage harvested. The analysis is confined to the five year period from 1919 to 1924 for the following reasons. In the first place, the requisite data are available for these years in the United States Censuses of Agriculture. In the second place, the most striking migration of the post-war period occurred during those years. Finally, both the agricultural and the industrial factors were operative. This relatively short period therefore constitutes a "sample" of Negro migration well suited to an analysis of its economic causes.

factors respectively, and let N, W, and C represent our indexes of Negro migration, white migration, and changes in the amount of cotton cultivated. Let each one of these series be expressed in terms of its standard deviation, and as deviations from its mean. Let us assume that the agricultural and industrial factors are independent of each other,[1] that is, that $r_{AI}=0$. Then we may write

$$(1) \quad N=r_{NA}A+r_{NI}I+e_N$$

as the regression equation [2] by which N may be estimated from A and I, together with the term e_N, representing the error involved in making such estimates. The two correlation coefficients, r_{NA} and r_{NI}, are the measures of the associations in which we are interested. It is the specific purpose of the analysis to evaluate these constants.

Corresponding to equation (1), are two others connecting the agricultural and industrial factors with white migration and with changes in the amount of cotton cultivated.

$$(2) \quad W=r_{WA}A+r_{WI}I+e_W$$
$$(3) \quad C=r_{CA}A+r_{CI}I+e_C.$$

Let us multiply equations (1) and (2), term by term.

$$\begin{aligned}(4) \quad NW=&r_{NA}r_{WA}A^2+r_{NI}r_{WI}I^2\\&+(r_{NA}r_{WI}+r_{NI}r_{WA})AI\\&+(r_{NA}A+r_{NI}I)e_W\\&+(r_{WA}A+r_{WI}I)e_N\\&+e_We_N.\end{aligned}$$

Let us sum equation (4) and divide by the number of counties. Since A and I are assumed to be uncorrelated, $\Sigma AI=0$ (these variables being measured from their respective means). The third term therefore drops out. It is easy to show that e_N and e_W are both uncorrelated with A and I.[3] The fourth and fifth terms of equation (4) are therefore each equal to zero. It may be assumed that e_N and e_W are not appreciably correlated with each other, since they represent population movements of the two races arising from the large number of non-

[1] This assumption seems to be fully justified by the facts of the case. An association between industrial labor demand and agricultural conditions would arise if labor agents sought out the regions of unusually depressed agriculture for their recruiting activities. Such may have been the case, taking the Cotton Belt as a whole. But the analysis in this article is confined to the counties of South Carolina and Georgia. Throughout this region, agriculture was hard hit, and it was presumably impossible for labor agents to discriminate to any appreciable degree among the various counties.

[2] The two regression coefficients in equation (1), $b_{NA\cdot I}$ and $b_{NI\cdot A}$, reduce respectively to r_{NA} and r_{NI}, because $r_{AI}=0$ and the three standard deviations are each equal to unity. This may be shown by substituting in the ordinary formula for the partial regression coefficient. See G. U. Yule, *An Introduction to the Theory of Statistics*, eighth ed., p. 238.

[3] For example, $\Sigma e_N A=\Sigma NA-r_{NA}\Sigma A^2-r_{NI}\Sigma AI$; or, $\Sigma e_N A=nr_{NA}-nr_{NA}=0$.

agricultural and non-industrial causes. Hence the last term of equation (4) will drop out in the process of summation. With respect to the two first terms on the right of the equal sign, it should be noted that $\Sigma\frac{A^2}{n}$ and $\Sigma\frac{I^2}{n}$ are both equal to unity. On the left of the equal sign, $\Sigma\frac{NW}{n}$ is equal to r_{NW} since these variables have means equal to zero and standard deviations equal to unity. Hence, in summing equation (4) and dividing by the number of counties, we get

$$(5) \quad r_{NW} = r_{NA}r_{WA} + r_{NI}r_{WI}.$$

Similarly, by multiplying equations (1) and (3), and equations (2) and (3), summing, and dividing by the number of counties, we have

$$(6) \quad r_{CN} = r_{NA}r_{CA} + r_{NI}r_{CI}$$
$$(7) \quad r_{CW} = r_{CA}r_{WA} + r_{CI}r_{WI}.$$

The quantities on the left of the equal signs in the three foregoing equations are given by the available data. On the right of the equal signs are six unknowns, r_{CA}, r_{CI}, r_{WA}, r_{WI}, r_{NA}, and r_{NI}. While we are interested only in the two last unknowns, it is necessary to eliminate the other four in order to evaluate the two last. Hence, we need six equations among the six unknowns, three more than we now have.

The industrial factor affects cotton acreage only as it affects the number of persons available to cultivate the cotton. In terms of partial correlation, then, we may put,

$$(8) \quad r_{CI \cdot NW} = 0.$$

It follows that

$$(9) \quad \frac{r_{CI \cdot N} - r_{CW \cdot N}r_{WI \cdot N}}{\sqrt{1 - r^2_{CW \cdot N}}\sqrt{1 - r^2_{WI \cdot N}}} = 0.$$

Whence,

$$(10) \quad r_{CI \cdot N} = r_{CW \cdot N}r_{WI \cdot N}.$$

Substituting for the partial coefficients in this equation, and cancelling, we get one more equation, namely

$$(11) \quad r_{CI} = Rr_{NI} + Sr_{WI}$$

in which

$$(12) \quad S = \frac{r_{CW} - r_{CN}r_{WN}}{1 - r^2_{WN}}$$

and

$$(13) \quad R = r_{CN} - Sr_{WN}.$$

It is also approximately true that the industrial factor had no effect upon cotton acreage if changes in the white population tended to counterbalance changes in the colored population. (It would be strictly true if the average cotton acreage of white farmers were exactly equal to the average cotton acreage of colored farmers, this average being the same in 1919 and 1924.) Let T be equal to the percentage change in the total number of farmers, this being an index of the change in total population. Then, we may put

$$r_{CI \cdot T} = 0 \tag{14}$$

or

$$r_{CI} = r_{CT} r_{TI} \tag{15}$$

provided neither r_{CT} or r_{TI} is equal to unity. On the right of the equal sign, the first factor, r_{CT}, may be obtained from the available data, and the problem at hand is to evaluate r_{TI}.

If p is the proportion of colored farmers in 1919 and q $(=1-p)$ is the proportion of white farmers, then it is easy to show that in the original units [1]

$$T = pN + qW. \tag{16}$$

Multiplying equation (16) by I, summing, and putting σ_I equal to unity, we get

$$n r_{TI} \sigma_T = \Sigma IpN + \Sigma IqW \tag{17}$$

in which n is the number of counties. The problem now is to evaluate the two triple product-sums on the right of the equal sign. This may be done as follows.

$$\Sigma IpN = n \sigma_{(pN)} r_{I(pN)} \tag{18}$$

The two factors on the right of the equal sign are approximately equal to the following expressions: [2]

$$\sigma_{(pN)} = \bar{p}\bar{N} \sqrt{V^2_p + V^2_N + 2 V_p V_N r_{pN}} \tag{19}$$

$$r_{I(pN)} = \frac{V_p r_{pI} + V_N r_{NI}}{\sqrt{V^2_p + V^2_N + 2 V_p V_N r_{pN}}} \tag{20}$$

[1] Let the subscript 0 denote the absolute number in 1919 and the subscript 1, the absolute number in 1924. For the moment, let T, N and W be proportionate changes, that is, percentage changes divided by 100 per cent. Then, $T = \frac{N_1 + W_1}{N_0 + W_0} - 1$.

$$\text{Or, } T = \frac{N_1}{N_0 + W_0} + \frac{W_1}{N_0 + W_0} - 1. \quad \text{Now, } \frac{N_1}{N_0 + W_0} = \frac{N_1}{N_0} \cdot \frac{N_0}{N_0 + W_0} = (N+1)p.$$

Similarly, $\frac{W_1}{N_0 + W_0} = (W+1)q$. And since $p+q=1$, $T = Np + p + Wq + q - 1 = Np + Wq$. Multiplying through by 100 per cent, we get the same equation in percentage terms.

[2] E. J. Gumbel, "Spurious Correlation and Its Significance to Physiology," this JOURNAL, June, 1926, pp. 181, 187.

in which V is equal to the standard deviation divided by the mean, and $\overline{p}$ and $\overline{N}$ are the means of the respective series.

Multiplying equations (19) and (20), and substituting in equation (18), we have,

$$(21) \quad \Sigma IpN = n\overline{p}\overline{N}(V_p r_{pI} + V_N r_{NI}).$$

We may assume that r_{pI} is of negligible value, and therefore drop out the first term, putting

$$(22) \quad \Sigma IpN = n\overline{p}\overline{N}V_N r_{NI} = n\overline{p}\sigma_N r_{NI}.$$

Similarly, since $r_{qI} = 0$, if $r_{pI} = 0$, we may put

$$(23) \quad \Sigma IqW = n\overline{q}\sigma_W r_{WI}.$$

Substituting equations (22) and (23) in equation (17), and dividing by n, we get

$$(24) \quad \sigma_T r_{TI} = \overline{p} r_{NI}\sigma_N + \overline{q} r_{WI}\sigma_W.$$

Substituting equation (24) in equation (15), we have

$$(25) \quad r_{CI} = E r_{NI} + F r_{WI}$$

in which

$$(26) \quad E = \frac{r_{CT}\overline{p}\sigma_N}{\sigma_T}$$

and

$$(27) \quad F = \frac{r_{CT}\overline{q}\sigma_W}{\sigma_T}.$$

It simplifies the mathematics somewhat if we convert equations (11) and (25) into two others, each containing only two of the three correlation coefficients involved. Let us put

$$(28) \quad r_{CI} = M r_{NI}$$

and

$$(29) \quad r_{WI} = L r_{NI}.$$

Solving equations (11) and (25), we get

$$(30) \quad M = \frac{ES - RF}{S - F}$$

and

$$(31) \quad L = \frac{E - R}{S - F}.$$

Let us take one more equation of the same form as equations (28) and (29)

$$(32) \quad r_{WA} = K r_{NA}.$$

The value of K will be discussed presently.

To solve for the six unknown correlation coefficients of the problem we now have six equations, namely, equations (5), (6), (7), (28), (29) and (32).

Substituting equations (28), (29) and (32) in equations (6) and (7), solving the resulting equations for $r_{CA}r_{NA}$, equating, and then solving for r^2_{NI}, we get

$$(33) \quad r^2_{NI} = \frac{Kr_{CN} - r_{CW}}{M(K-L)}.$$

Substituting equations (29) and (32) in equation (5), and solving for r^2_{NA}, we get

$$(34) \quad r^2_{NA} = \frac{r_{NW} - Lr^2_{NI}}{K}$$

in which the value of r^2_{NI} is already given by equation (33).

Equations (33) and (34) give us the values of the desired correlation coefficients in terms of constants all of which are given by the data except K. No equation has been found connecting the value of K with the known quantities of the problem. This deficiency, however, does not prevent us from reaching conclusions in the analysis, and in fact illustrates two very useful principles of procedure in connection with the mathematical method pursued here. The first of these is the approximate evaluation of constants from our general non-quantitative information concerning the problem at hand. The second principle consists of the selection of a whole range of probable values for a given constant rather than a single value. It is sometimes possible, as in the present case, to draw useful conclusions which hold for any value of the constant within such a range.

The amount of Negro migration arising from agricultural causes, in a given county, from 1919 to 1924, in percentage terms, is given by the expression[1]

$$(35) \quad \frac{\sigma_N r_{NA} A}{\sigma_A}.$$

Similarly, the amount of white migration in the same county, due to agricultural conditions, is given by

$$(36) \quad \frac{\sigma_W r_{WA} A}{\sigma_A}.$$

[1] This expression is what the first term on the right of the equal sign in equation (1) becomes when N and A are expressed in their original units.

Putting the ratio of the second expression to the first equal to t, substituting Kr_{NA} for r_{WA}, cancelling, and solving for K, we get

$$(37) \quad K = \frac{\sigma_N}{\sigma_W} t$$

in which, to repeat, t is the ratio of the index of "agricultural" migration of whites to the index of "agricultural" migration of Negroes. Since σ_N and σ_W are given by the data, K may be evaluated if t is known.

The relative impact of agricultural conditions upon the white and Negro population depends largely upon their relative dependence upon the particular form of agriculture being practiced, their relative technical competence, and their relative financial resources. An examination of southern agricultural conditions from these three standpoints leads one to believe that the value of t lies somewhere between 0.5 and 1.0.[1] In the subsequent analysis, therefore, the value of K is taken to lie somewhere in the interval between the two points corresponding to these values of t.[2]

The analysis just set forth has been applied to a group of 72 counties in Georgia and South Carolina. In this section of the Cotton Belt, a

TABLE I

BASIC DATA DERIVED FROM 72 COUNTIES IN SOUTH CAROLINA AND GEORGIA

r_{CN}	0.77
r_{CW}	0.43
r_{NW}	0.49
r_{CT}	0.85
$\bar{p}$	0.54
σ_N	19
σ_W	11
σ_C	24
σ_T	14

substantial emigration of Negroes occurred during the period from 1919 to 1924. In this section also both the agricultural and the industrial factors were apparently very strong. The data applying to these 72 counties are presented in Table I. Table II contains the estimated coefficients of correlation found by applying equations (33) and (34) to the data of Table I. It will be seen that for both values of K, r_{NI} is very much greater than r_{NA}. It is easy to show[3] that if K has any value between the limits 0.87 and 1.73, the coefficients of correlation will lie between the corresponding values in Table II. But the chances

[1] See E. E. Lewis, *op. cit.* pp. 78ff for a full discussion of the point.

[2] Specifically, from equation (37) we get $K = 0.87$ and $K = 1.73$.

[3] By substitution from Table I, the expressions found in equations (33) and (34) may be written as functions of K alone. The first derivatives of these two functions have no real zeroes between $K = 0.87$ and $K = 1.73$. Hence the functions are monotonic between these values.

TABLE II

COEFFICIENTS OF CORRELATION BETWEEN NEGRO MIGRATION, AND THE INDUSTRIAL AND AGRICULTURAL FACTORS, FOR TWO VALUES OF K

	$K=0.87$	$K=1.73$
r_{NI}	0.83	0.96
r_{NA}	0.32	0.11

are that the value of K did actually lie between the two limits chosen. Hence we are able to conclude that the coefficient r_{NI} was very much greater than the coefficient r_{NA}, in spite of the fact that the actual value of K is unknown. Furthermore, we have set relatively narrow limits to the values of these coefficients. The use of a range of values for a constant rather than any single value relieves the analysis of some rigidity with respect to its underlying assumptions. It is perhaps needless to point out, however, that the device will yield results only under very special circumstances.

The method by which these results have been obtained requires some discussion. The general procedure may be characterized as "mathematical" rather than as strictly "statistical." It consists of a symbolic formulation of the relationships obtaining among the several elements of the problem; such a formulation constituting a theoretical framework by means of which the data may be viewed in correct perspective. The mathematical manipulation of these symbolic statements of the problem brings to light the quantitative relations implicit in the data. In the present paper, the relative importance of the underlying factors is found through mathematical analysis, to be revealed by the measures of the associations (e.g. r_{CN}) to which they give rise. As a result, the data serve our purpose more adequately than they otherwise could.

It should be noted that the aim of the method is not greater precision of values. There is none of the emphasis, so often completely unjustified, upon numerical "refinement" of results, such as one finds in much of the current use of the so-called "corrections." The aim of the method is rather to answer questions which without its aid would not be answered at all. Moreover, the mathematical method does not "manipulate" the data in the same sense that many of the current transformations do, and this is true in spite of the fact that it involves an unusual number of arithmetical operations upon the data. To transform a given series into reciprocals or logarithms for the sole reason that such a transformation gives one somewhat higher correlation coefficients is a questionable procedure. But to go through a much

more elaborate process of transformation, when this process has a specific meaning in terms of the actual problem being studied, is quite a different matter. The proper criterion for choosing methods of analysis would seem to be not that the methods be as simple as possible, but that, simple or complex, they should at all points be significant in terms of the problem under investigation.[1]

It is perhaps unfair to the mathematical method that it proceeds so obviously by means of the accumulation of assumptions. This apparent weakness, however, constitutes from one point of view a considerable strength. Any line of reasoning proceeds in somewhat the same fashion, i.e. by the addition of premises either explicitly stated or tacitly assumed. It is the peculiar virtue of the mathematical method that it brings to light a greater proportion of the foundations underlying an argument than the "literary" method. Furthermore, the precise statement of assumptions not only calls attention to them, but also facilitates a discussion of the important question as to how closely they fit the actual facts. Finally, while the mathematical method proceeds by the accumulation of rigidly formulated assumptions, and yields its results in precise numerical form, these results are themselves subject to broad interpretation. It is the "general magnitude" of the measures in Table II rather than their precise values which should interest us.

The methodological difficulties which characterize the present problem, namely, the impossibility of measuring the two underlying factors, are often found in other problems which we should like to attack. The mathematical method furnishes a means of indirect approach by which both general non-statistical information and related statistical series can be made to yield results which would have been yielded by quantitative data directly concerning the elements of the problem. This type of analysis offers the possibility of a much more complete exploitation of the statistical information now available than that yielded by the "empirical" methods of ordinary statistical procedure.

[1] Cf. M. C. Rorty, "Statistics and the Scientific Method," this JOURNAL, March, 1931, p. 8.

GRAPHIC COMPARISONS BY BARS, SQUARES, CIRCLES, AND CUBES

By Frederick E. Croxton, *Columbia University*, and Harold Stein, *Brooklyn College* [1]

In an earlier issue of this Journal an attempt was made to evaluate bar charts and pie diagrams as graphic devices for showing component parts.[2] The present article deals with the relative merits of bars, squares, circles, and cubes for showing simple comparisons. Most users of statistical charts have been accustomed to believe that linear comparisons, represented by bar charts, can be judged with much more accuracy than can area comparisons, such as squares and circles, and that either is superior to volume comparisons, such as cubes. It is the purpose of this investigation to test these types of diagrams to ascertain which, if any, may be preferable from the point of view of the accuracy of the estimates made from them.

The relationships shown by the squares and circles used in this study were represented by the respective areas of the diagrams, while the relationships shown by the cubes were represented by their volumes. The fact that the actual volume of a solid can be only suggested by a two-dimension drawing may be one of the reasons why the accuracy of judgments based upon the drawings of cubes proved to be relatively low. In popular publications comparisons by circles, squares, cubes, and various pictorial means are frequently drawn on a linear basis rather than upon the proper area or volume basis. Furthermore, the reader is frequently at a loss to know upon what basis they are drawn. Careful computations have revealed that some diagrams, whether considered as linear, area, or volume comparisons, give only a very rough approximation of the figures which they undertake to present.

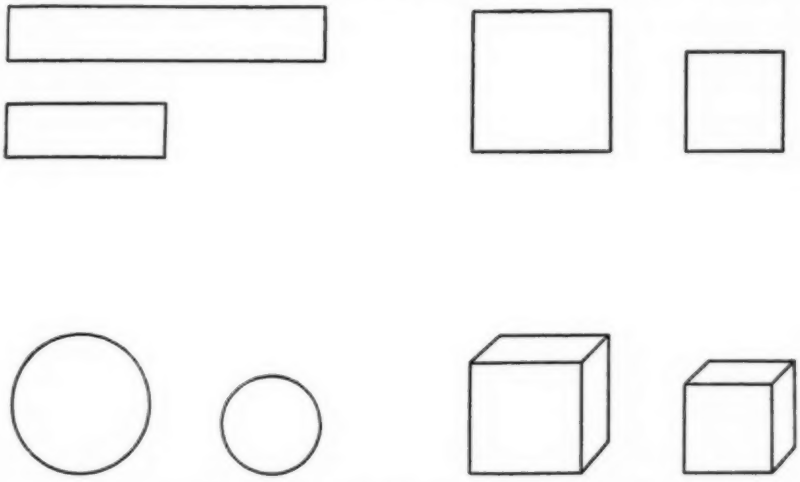
The data which follow are the results of estimates made by 550 observers and the diagrams used were 40 in number. The 40 diagrams, each on a separate card, formed nine sets. Each set consisted of a comparison by means of bars, squares, circles, and cubes showing the same ratio, as shown in Chart I; in addition an alternate arrangement of squares and circles with the diagrams centered as in Chart II, was included in two of the sets. The diagrams were presented one at a

[1] The writers wish to express their gratitude to those instructors and students who made it possible to obtain the data used in this analysis and to Mr. William Madow and Mr. Charles H. Wittmann who assisted in the computations.

[2] "Bar Charts Versus Circle Diagrams," by Frederick E. Croxton and Roy E. Stryker, this Journal, December, 1927.

CHART I

BARS, SQUARES, CIRCLES, AND CUBES SHOWING 50 TO 100 RELATIONSHIP



time to the observers in such an order that it was not obvious that the charts were in sets. For each diagram the observers undertook to estimate the size of the smaller figure in relation to the larger one. As in the earlier study referred to above, all diagrams were drawn without scales, as in Charts I and II, in order that the estimates of the observers might be based upon the diagrams alone and not influenced by the scales.

CHART II

CIRCLES CENTERED AND SQUARES CENTERED SHOWING 50 TO 100 RELATIONSHIP

Bars versus Squares. The first part of Table I presents the results obtained from comparing the estimates made of nine pairs of bars and nine pairs of squares. The mean error resulting from judging the bars was in each instance smaller than that resulting from observing the squares. In eight of the nine instances shown in the table the differences between the mean errors was significant, while in one case it was not.

Bars versus Circles. As shown in the second part of Table I, estimates based upon bars were more accurate than those based upon

circles. For each of the nine comparisons of bars and circles the advantage lay with the bars. The differences between the mean errors were significant in eight cases out of the nine.

Bars versus Cubes. Bars showed an even greater superiority over cubes than over either squares or circles. The third part of Table I indicates that in each case the mean error resulting from estimating the proportion shown by bars was smaller than the mean error resulting from estimating the cubes. In each case, also, the difference between the mean errors was significant.

TABLE I

ERRORS RESULTING FROM ESTIMATES OF BARS AND SQUARES, BARS AND CIRCLES, AND BARS AND CUBES

Percentage shown	Mean error for bars	Mean error for other diagram	Advantage in favor of:	Observed difference	Difference ÷ σ difference	Significant?
Bars and Squares						
2.00	2.42	2.50	bars	.08	.4	no
12.50	2.83	5.07	bars	2.24	4.6	yes
16.67	2.98	5.17	bars	2.19	6.1	yes
25.00	3.04	4.36	bars	1.32	3.1	yes
33.33	2.55	8.77	bars	6.22	13.8	yes
50.00	1.54	15.58	bars	14.04	33.4	yes
66.67	3.67	12.49	bars	8.82	26.7	yes
70.00	4.44	11.92	bars	7.48	27.7	yes
90.00	3.00	4.73	bars	1.73	8.2	yes
Bars and Circles						
2.00	2.42	2.78	bars	.36	2.1	?
12.50	2.83	6.21	bars	3.38	6.8	yes
16.67	2.98	6.37	bars	3.39	10.0	yes
25.00	3.04	6.47	bars	3.43	9.5	yes
33.33	2.55	8.72	bars	6.17	15.0	yes
50.00	1.54	9.73	bars	8.19	21.6	yes
66.67	3.67	8.98	bars	5.31	15.2	yes
70.00	4.44	9.37	bars	4.93	16.4	yes
90.00	3.00	6.52	bars	3.52	15.3	yes
Bars and Cubes						
2.00	2.42	7.16	bars	4.74	16.9	yes
12.50	2.83	10.02	bars	7.19	13.8	yes
16.67	2.98	14.41	bars	11.43	21.2	yes
25.00	3.04	19.23	bars	16.19	24.5	yes
33.33	2.55	19.18	bars	16.63	29.7	yes
50.00	1.54	19.83	bars	18.29	42.5	yes
66.67	3.67	14.64	bars	10.97	32.3	yes
70.00	4.44	14.31	bars	9.87	31.8	yes
90.00	3.00	5.96	bars	2.96	12.9	yes

Squares versus Circles. From the data shown in the first part of Table II it would appear that there is little difference in the accuracy of estimates based on squares and circles. In five instances the mean error in estimating the squares was smaller than the mean error in estimating the circles; in two of these the difference between the

means was significant and in a third it was probably significant. In four instances the mean error in estimating the circles was smaller than the mean error in estimating the squares; in three of these the difference between the means was significant.

Squares versus Cubes. Estimates based upon squares are clearly more accurate than those based upon cubes. The second part of Table II shows that in each instance the mean error in estimating the squares was smaller than that in estimating the cubes and that in each instance the difference between the mean errors was significant.

TABLE II
ERRORS RESULTING FROM ESTIMATES OF SQUARES AND CIRCLES, AND SQUARES AND CUBES

Percentage shown	Mean error for squares	Mean error for other diagram	Advantage in favor of:	Observed difference	Difference ÷ σdifference	Significant?
Squares and Circles						
2.00	2.50	2.78	squares	.28	1.3	no
12.50	5.07	6.21	squares	1.14	2.2	?
16.67	5.17	6.37	squares	1.20	2.9	probably
25.00	4.36	6.47	squares	2.11	4.8	yes
33.33	8.77	8.72	circles	.05	.1	no
50.00	15.58	9.73	circles	5.85	10.8	yes
66.67	12.49	8.98	circles	3.51	9.2	yes
70.00	11.92	9.37	circles	2.55	7.3	yes
90.00	4.73	6.52	squares	1.97	7.8	yes
Squares and Cubes						
2.00	2.50	7.16	squares	4.66	14.6	yes
12.50	5.07	10.02	squares	4.95	9.5	yes
16.67	5.17	14.41	squares	9.24	15.9	yes
25.00	4.36	19.23	squares	14.87	21.2	yes
33.33	8.77	19.18	squares	10.41	15.3	yes
50.00	15.58	19.83	squares	4.25	7.5	yes
66.67	12.49	14.64	squares	2.15	5.8	yes
70.00	11.92	14.31	squares	2.39	6.8	yes
90.00	4.73	5.96	squares	1.23	5.3	yes

Circles versus Cubes. Estimates based upon circles seem to be more accurate than those based upon cubes. In Table III it may be seen

TABLE III
ERRORS RESULTING FROM ESTIMATES OF CIRCLES AND CUBES

Percentage shown	Mean error for circles	Mean error for cubes	Advantage in favor of:	Observed difference	Difference ÷ σdifference	Significant?
2.00	2.78	7.16	circles	4.38	14.6	yes
12.50	6.21	10.02	circles	3.81	7.1	yes
16.67	6.37	14.41	circles	8.04	14.1	yes
25.00	6.47	19.23	circles	12.76	19.3	yes
33.33	8.72	19.18	circles	10.46	16.1	yes
50.00	9.73	19.83	circles	10.10	18.4	yes
66.67	8.98	14.64	circles	5.66	14.5	yes
70.00	9.37	14.31	circles	4.94	13.4	yes
90.00	6.52	5.96	cubes	.56	2.3	?

that in eight instances the mean error in estimating circles was smaller than the mean error in estimating cubes and that in each of these instances the difference between the means was significant.

Squares centered versus other forms. As stated above, two diagrams of squares were included in which the squares were centered as in Chart II. As indicated in Table IV estimates made from bars appear to be more accurate than those made from squares centered, and estimates based upon squares centered are more accurate than those based upon cubes.

One reason for including squares centered was to ascertain if estimates made from them were more or less accurate than estimates made from squares drawn to the same base line. There seems to be no clear evidence in Table IV that either is superior. No conclusive statement can be made as to the relative merits of squares centered on the one hand and of circles, and circles centered on the other.

TABLE IV
ERRORS RESULTING FROM ESTIMATES OF SQUARES CENTERED AND OTHER DIAGRAMS

Percentage shown	Mean error for squares centered	Mean error for other diagram	Advantage in favor of:	Observed difference	Difference ÷ σdifference	Significant?
Squares Centered and Bars						
25.0	3.99	3.04	bars	.95	2.4	?
50.0	12.10	1.54	bars	10.56	27.1	yes
Squares Centered and Squares						
25.0	3.99	4.36	squares centered	.37	.8	no
50.0	12.10	15.58	squares centered	3.48	6.4	yes
Squares Centered and Circles						
25.0	3.99	6.47	squares centered	2.48	6.2	yes
50.0	12.10	9.73	circles	2.37	4.6	yes
Squares Centered and Circles Centered						
25.0	3.99	6.79	squares centered	2.80	6.5	yes
50.0	12.10	10.95	circles centered	1.15	2.2	?
Squares Centered and Cubes						
25.0	3.99	19.23	squares centered	15.24	22.4	yes
50.0	12.10	19.83	squares centered	7.73	14.1	yes

Circles centered versus other forms. Two sets of circles centered (as in Chart II) were also included. Table V indicates that estimates based upon bars were more accurate than those based upon circles centered and that estimates based upon circles centered were more accurate than those based upon cubes. It was thought that estimates based upon circles centered might prove to be more or less accurate than estimates based upon circles drawn to the same base line. The data of Table V show no definite proof that either is superior. No conclusive statement can be made as to the relative merits of circles centered on the one hand and of squares, squares centered, and circles on the other hand.

TABLE V

ERRORS RESULTING FROM ESTIMATES OF CIRCLES CENTERED AND OTHER DIAGRAMS

Percentage shown	Mean error for circles centered	Mean error for other diagram	Advantage in favor of:	Observed difference	Difference ÷ σdifference	Significant?
Circles Centered and Bars						
25.0	6.79	3.04	bars	3.75	9.4	yes
50.0	10.95	1.54	bars	9.41	23.5	yes
Circles Centered and Squares						
25.0	6.79	4.36	squares	2.43	5.2	yes
50.0	10.95	15.58	circles centered	4.63	8.4	yes
Circles Centered and Squares Centered						
25.0	6.79	3.99	squares centered	2.80	6.5	yes
50.0	10.95	12.10	circles centered	1.15	2.2	?
Circles Centered and Circles						
25.0	6.79	6.47	circles	.32	.8	no
50.0	10.95	9.73	circles	1.22	2.3	?
Circles Centered and Cubes						
25.0	6.79	19.23	circles centered	12.44	18.3	yes
50.0	10.95	19.83	circles centered	8.88	15.9	yes

The results of this quantitative evaluation of the relative merits of bars, squares, circles, and cubes may be summed up as follows:

(1) Estimates based upon bar charts were more accurate than estimates based upon squares, circles, or cubes.

(2) Estimates based upon squares and estimates based upon circles showed no conclusive evidence that one form of presentation is superior to the other.

(3) Estimates based upon squares were more accurate than estimates based upon cubes.

(4) Estimates based upon circles were more accurate than estimates based upon cubes.

(5) Estimates based upon squares centered and upon circles centered were more accurate than estimates based upon cubes, but less accurate than estimates based upon bars.

(6) In making comparisons by means of squares and circles it appears (upon limited evidence) that it makes no difference in the accuracy of estimates whether the figures be centered or drawn upon the same base line.

It will be noted (Chart I) that the bars used in this study were arranged one above the other and that the other figures were arranged side by side. While this is the method of arrangement most frequently encountered, it raises several points which must be left for later determination: Are estimates more accurate when based upon horizontal or vertical bars? If squares, circles, or cubes are to be used, is it preferable to arrange them side by side or one above the other? If vertical bars yield less accurate estimates than horizontal bars are they still clearly preferable to squares, circles, and cubes?

THE USE OF "TRENDS IN RESIDUALS" IN CONSTRUCTING DEMAND CURVES

By L. H. Bean and G. B. Thorne, *Bureau of Agricultural Economics*

The adoption of various devices for eliminating trends in time series has been influential in promoting price analysis, but these devices have not yet removed certain difficulties arising from the trend factor in constructing demand and supply curves or in forecasting. H. L. Moore supplied the initial impetus when he showed how demand curves could be developed by eliminating trend in one of two ways, by expressing data either as percentages of trend or as percentage first differences. Then B. B. Smith showed how the advantages of both of these methods could be combined in multiple correlation to obviate the weakness inherent in the first difference method. Recognizing certain weaknesses in adjusting each series of data for its separate trend, Smith further showed how to avoid this individual adjustment by using time as an independent factor, to obtain a sort of composite net trend derived from residual variations related to time, but unrelated to the other independent factors. Each of these devices tended to widen the possibilities of price analysis. They are all in current use with a tendency in favor of the composite trend in residuals.[1]

One of the attractive features of this latter device is that it enables one to deal specifically with a very few factors, to treat all other factors known or unknown in a sort of catch-all fashion, on the assumption that these "all other factors" have a composite influence which varies systematically or uniformly with time and that they can by this device be "held constant."

In view of the growing use of this latter device for handling the trend element, and the added impetus it is likely to give to price analysis, it is the purpose of this article to point out certain dangers that lurk in this assumption, and certain problems that the analyst should be aware of, particularly as they affect the construction and nature of demand (or other) curves and as they bear on forecasting from the derived curves and trends.

[1] For examples see, B. B. Smith, *Factors Affecting Price of Cotton;* U. S. Department of Agriculture *Technical Bulletin No. 50;* H. Schultz, *Meaning of Statistical Demand Curves;* L. H. Bean, "Farmers' Response to Price," *Journal of Farm Economics*, July, 1929.

The elimination of trend by the first difference method has the outstanding weakness that the percentage change for any one point in the series is affected by whatever error there may be in the preceding items. While this difficulty can be obviated by expressing the data as ratios to a trend, this latter procedure is often undesirable. In the first place, the kind of trend to eliminate depends on the trends in associated variables. Secondly, adjusting data for trend may eliminate one of the factors under investigation. For example, when H. L. Moore adjusted for trend and then correlated adjusted production and price of pig iron, he missed the negative relation between production and price and obtained instead the so-called positive demand curve. Both relations would have appeared had he made use of the simultaneous method of treating trends. But this method too has its weaknesses as the following examples will illustrate. The examples are taken from studies dealing with supply and demand factors in retail prices of beef and pork for the post-war period.

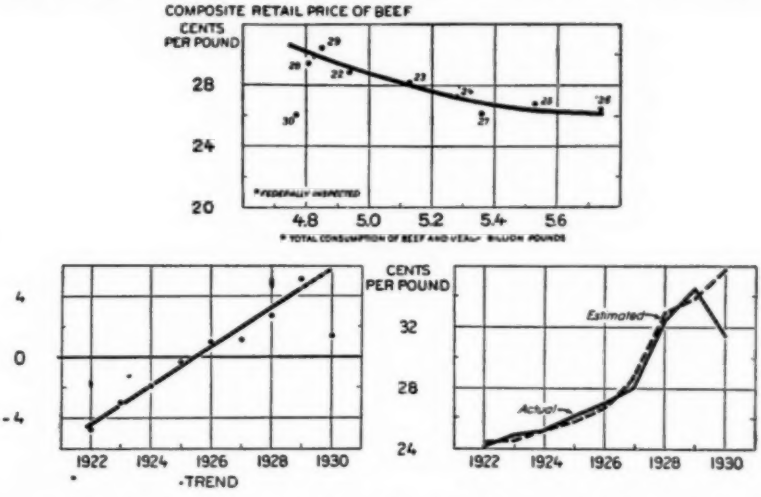
One of the purposes of this study is to determine the demand curve which according to economic theory would show the quantities which would be purchased at various specified prices at any one instant of time by all consumers in the United States combined; in other words, to show the shifts in the amount which would be purchased if the price were changed and demand conditions remained unchanged. Lacking a satisfactory method for determining what quantities buyers stand ready to buy for various specified prices at a certain instant of time, the usual alternative was first adopted of relating yearly quantities taken and prices paid. A scatter diagram of consumption and price indicated that the relation between these two factors shifted with time, that the shift was practically uniform. Consequently, correlating price with consumption and time, there is revealed a well defined demand curve and a trend in residuals uniformly related to time. The upper part of Chart I shows this relation between consumption of beef and a composite retail price of beef (representing about 65 per cent of the carcass). The lower part of the chart shows the residuals from the consumption-price relationship plotted against time.[1]

These results are typical of many cases where residuals related to time have been used to indicate changes in demand, or shifts in the demand schedule, and where it has been possible by so doing to obtain a close relation between supply and price. By using this device for holding constant all other factors (of the nature of which the analyst is usually ignorant) that vary with time, it is generally concluded that the

[1] For the graphic method of correlation used in the four analyses contained in this paper, see this JOURNAL, December, 1929, p. 386, and December, 1930, p. 428.

CHART I

RELATION OF BEEF PRICES TO CONSUMPTION AND TREND, 1922-1930



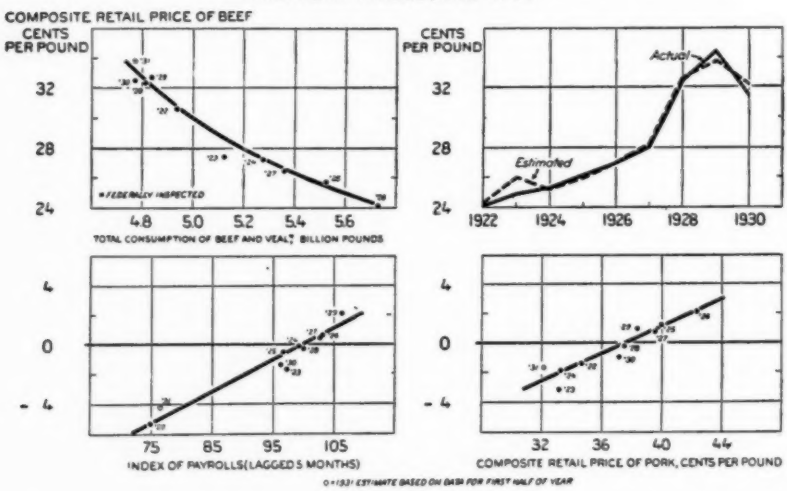
close relation between quantities sold and price received approximates the demand curve of theory and that the trend in residuals represents a vertical shifting of that curve. This method has been applied in constructing "demand curves" or supply and price relations for cotton, wheat, corn, apples, potatoes, sugar and a number of other commodities. No statistical explanation is given for the trend in residuals in these studies. Statements such as that it represents shifts in demand due to "growth in population etc.," or that it is "a catch-all for all the disturbing factors" in a dynamic society, constitute in most cases all the attention which has been given to explaining the trend.

In terms of the example in Chart I it might be assumed that the regular trend represents a growth in demand for beef during the period (1922–1929) and that the relation between consumption and price constitutes a true demand curve. Obviously the only justification for assuming that the trend in residuals represents changes in demand is that it moves along a regular course with time and that by removing it, a smooth logical relation of consumption and price is revealed. Furthermore, for practical purposes, the results imply that the elements which brought the regular increase in demand are sufficiently basic and stable to warrant a projection of the trend in making a price or consumption forecast. But when the data for 1930 are applied to the curves, they reveal the danger of making such an assumption in forecasting, since a forecast for 1930 from this preliminary analysis would have been woefully far from accurate.

This type of analysis thus raises certain questions: (1) Does the uniform trend in residuals actually represent an upward trend or shift in the demand curve? (2) If the residuals were explained by the separate elements which it represents, would it change materially the shape of the demand curve? (3) Would dealing with the separate factors causing shifts in the demand schedule instead of using a composite trend be more reliable in forecasting? The answers to these questions are indicated by a further analysis of retail beef prices. While these answers are of course to be taken only as applying to beef, they are intended also as illustrative of similar difficulties that may be found in other analyses where the method in question is applied.

CHART II

RELATION OF BEEF PRICES TO CONSUMPTION, CONSUMER INCOMES, AND PORK PRICES, 1922-1930



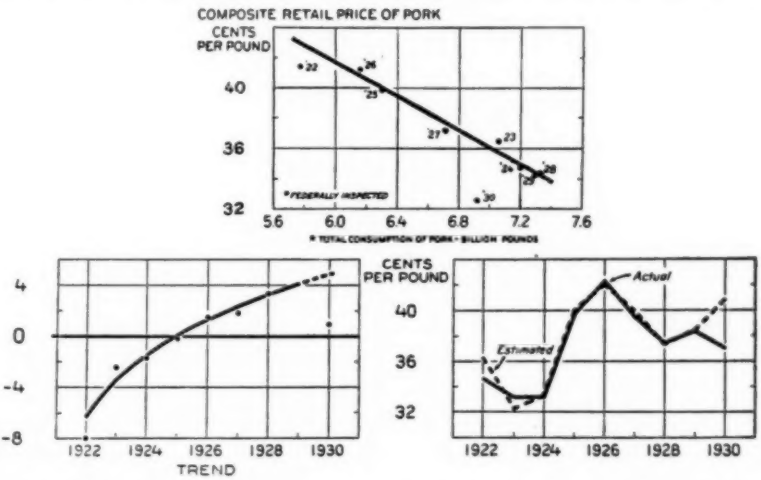
The reasons why a projection of the upward trend would have given an erroneous forecast for 1930 are revealed in Chart II. This analysis differs from the preceding one in the important respect that instead of using the time factor as a catch-all for forces which cause shifts in the demand curve for beef, there are included two of those forces or factors and they are treated separately in their influence on beef prices. These two factors are the retail price of pork, and the buying power of consumers as measured by an index of factory payrolls. In this example the three factors, consumption, retail pork prices and money incomes of consumers explain or account for most of the annual variations in beef prices. The changes in demand which in the first analysis appeared to

be uniform are here revealed to have been the result of changes in pork prices and in consumers' incomes. By comparing Charts I and II it becomes evident (1) that the changes in demand for beef between 1922 and 1929 did not conform to a regular upward trend, (2) that the relation between consumption and price as shown in Chart II differs from that in Chart I, the latter showing nearly a 4 cent decline in price from 30.2 cents to 26.4 cents for the given range of consumption, while the other a 9 cent decline from 33.2 to 24.1 cents.

Results obtained from a similar treatment of the supply and demand factors in retail pork prices are shown in Charts III and IV. Again it was found that by assuming a relation between consumption and price

CHART III

RELATION OF PORK PRICES TO CONSUMPTION AND TREND, 1922-1930

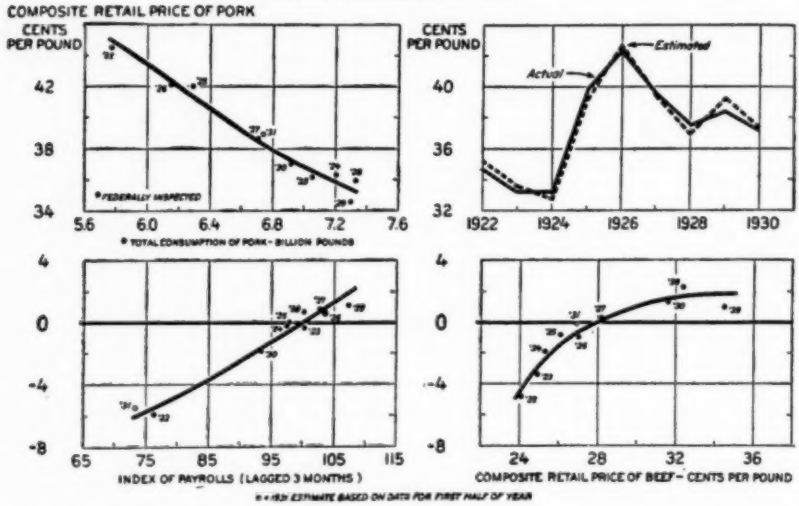


such as shown in the upper part of Chart III a well defined demand curve and regular upward trend in residuals related to time could be established from 1922 to 1929. This trend in residuals, although curvilinear rather than linear, is equally as regular in its year-to-year changes as the trend revealed in the study of beef prices. Furthermore, just as in the latter, a projection of the trend for the purpose of making a forecast for 1930 would have resulted in serious error.

By substituting for the "time" element two important factors affecting the demand for pork, namely the money incomes of consumers as measured by an index of factory payrolls and retail beef prices, most of the annual variations in pork prices are explained for the entire period 1922–1930. Results of this analysis are shown in Chart IV. The

CHART IV

RELATION OF PORK PRICES TO CONSUMPTION, CONSUMER INCOMES, AND BEEF PRICES, 1922-1930



same general conclusions then, are to be drawn from a comparison of Charts III and IV as are indicated by a comparison of Charts I and II, for it is again evident (1) that the changes in demand between 1922 and 1929 did not conform to a regular upward trend, (2) that the relation between consumption and price when the actual demand factors are used differs from that revealed when an unexplained trend related to time is used to represent the changes in demand, a linear relation being indicated in one case and a slightly curvilinear one in the other, and (3) that the decrease in demand in 1930 was associated with a decrease in consumer incomes and a decline in retail prices of the most important competing meat. It may be observed, however, that there is only a slight difference in the two consumption-price relations shown in Charts III and IV, in contrast to the marked difference in these relations in Charts I and II.

These two examples illustrate the dangers involved in using "time" as an independent factor in correlation analysis, regardless of whether the objective is to construct a forecasting formula or to derive a demand curve, or both. The element of judgment is vitally important in making forecasts. The time has not come, and probably never will, when reliable forecasts can be made simply through the application of empirical formulae without regard to the reasonableness of the forecasts in view of other indications. It becomes additionally difficult to appraise the reliability of a forecast based on statistical analysis

when it involves the use of an unexplained trend related to time and when the analyst is uninformed as to the nature of the factor or factors represented in the trend. This holds true even though the trend is an accurate reflection of the composite influence of factors other than those included in the study, and if the time factor reveals a spurious relationship such as in the two studies described above, the analysis is of dubious value. The fact that in one of the above illustrations there was only a small difference in the consumption-price relations suggests that the time factor may sometimes be employed to obtain a satisfactory net relation for a given period, but unless the result is also tested by a more comprehensive analysis the validity of that net relation must remain in doubt. Even a larger number of observations than that used in these illustrations would not remove the unreliability of results based on a "time" factor. It is true that the larger the number of observations, the greater the probability that the trend in residuals is not a spurious relation. Even though it be a true relation, however, it may break down after the end of, say, 20 or 25 years just as it may after a shorter period. Practically all long-time price analyses employing "trend in residuals" have demonstrated this weakness.

NOTES

SOME CHARACTERISTICS OF THE GRAPHIC METHOD OF CORRELATION

By Warren C. Waite

Methods of graphic correlation have been presented recently, and have been widely employed, particularly in the study of agricultural prices. The procedures are of two principal types. The first is the curvilinear correlation method in which a regular multiple correlation is first computed and the net regression lines later modified by graphic methods in view of the position of the residuals about the partial regression lines. The second, more commonly called the "graphic method," starts with a gross regression between two variables and successively compares the relation of residuals with the values of new variables. The comments of this note apply only to the latter method. The cases treated are for simplicity of only three variables and the relationships considered linear. Moreover the regression lines are all those of least square fit, since these permit a somewhat more rigorous demonstration of the point. The conclusions are applicable by analogy to the cases where the lines are not those of least square fit and where they are curvilinear.

The regression equation for the classical procedure in correlation is of the form $x_{1c}=b_{12.3}x_2+b_{13.2}x_3$, where x_{1c} is the estimated value of x_1 and $b_{12.3}$ and $b_{13.2}$ are the net regressions. The estimating equation for the graphic procedure is of the form $x_{1c}=b_{12}x_2+b_{(1.2)3}x_3$, where b_{12} is the gross regression between x_1 and x_2, and $b_{(1.2)3}$ is the regression between the residuals of x_1 after its estimation from x_2 (i.e. $x_1-b_{12}x_2$) and x_3. In case we begin our graphic procedure with x_3 our equation is of the form $x_{1c}=b_{13}x_3+b_{(1.3)2}x_2$. We need to examine, in consequence, the x_{1c} arrived at by the various methods, and how b_{12} may differ from $b_{12.3}$ and $b_{(1.2)3}$ from $b_{13.2}$.

Consider first, the case where there is no correlation between the independent variables, i.e. $r_{23}=0$. We know (Yule, p. 237) that

$$b_{12.3}=\frac{b_{12}-b_{13}b_{32}}{1-r^2_{23}}. \qquad (1)$$

Similarly it can be shown that [1]

$$b_{(1.2)3} = b_{13} - b_{12}b_{23}. \tag{2}$$

When $r_{23} = 0$, it is apparent from (1) that $b_{12} = b_{12.3}$ and $b_{13} = b_{13.2}$, and from (2) that $b_{(1.2)3} = b_{13}$ and $b_{(1.3)2} = b_{12}$. In these circumstances the two methods give identical results, and it makes no difference which independent variable is used first in the graphic approach.

In the cases where there is correlation between the independent variables, and this is the situation in the majority of our problems, the result is not so fortunate. We see from (1) that b_{12} is not equal to $b_{12.3}$ and will differ markedly if r_{23} is large. Writing $b_{13.2}$ in the form of (1) we have:

$$b_{13.2} = \frac{b_{13} - b_{12}b_{23}}{1 - r^2_{23}}. \tag{3}$$

Examining (2) and (3) we see the difference lies in the inclusion of the $1 - r^2_{23}$ in the denominator of (3). This means that when r_{23} is large the two regressions will differ materially. Moreover, it will be possible for $b_{(1.2)3}$ to be of opposite sign from b_{13} whenever the product of b_{12} and b_{23} is of the same sign and greater than b_{13}. In such cases we will attribute a positive or negative influence to x_3 depending upon whether we begin our analysis with x_3 or include it later.

The estimating equation using (2) above, becomes

$$x_{1c} = b_{12}x_2 + (b_{13} - b_{12}b_{23})x_3, \text{ or} \tag{4}$$

$$x_{1c} = b_{13}x_3 + (b_{12} - b_{13}b_{32})x_2 \tag{5}$$

depending upon the variable with which we begin our analysis. In these equations $b_{12}x_2$ and $b_{13}x_3$ are common to both. It is thus evident that the x_{1c} will be the same in the two cases only if $b_{12}b_{23}x_3$ is equal to $b_{13}b_{32}x_2$, and that this will seldom be true. Thus we will generally secure different estimates of our dependent variable depending upon the order in which we consider our independent variables, and our index of correlation will differ somewhat.

From the above we may conclude, even though straight lines of least square fit are used for the regressions:

(1) That the graphic method of correlation will generally yield

[1] This may be shown as follows:

$$r_{s_{1.3}s} = \frac{\frac{\Sigma x_{1.3}x_3}{N}}{\sigma_{s_{1.3}}\sigma_3} = \frac{\frac{\Sigma(x_1 - b_{13}x_3)x_3}{N}}{\sigma_1(1-r^2_{13})^{\frac{1}{2}}\sigma_3} = \frac{\frac{\Sigma x_1x_3}{N} - b_{13}\frac{\Sigma x_3x_3}{N}}{\sigma_1(1-r^2_{13})^{\frac{1}{2}}\sigma_3} = \frac{r_{13}\sigma_1\sigma_3 - r_{13}\frac{\sigma_1}{\sigma_3}r_{33}\sigma_3\sigma_3}{\sigma_1\sigma_3(1-r^2_{13})^{\frac{1}{2}}} = \frac{r_{13} - r_{13}r_{33}}{(1-r^2_{13})^{\frac{1}{2}}}$$

$$b_{(1.3)_2} = r_{s_{1.3}2}\frac{\sigma_{s_{1.3}}}{\sigma_2} = \frac{r_{12} - r_{13}r_{32}}{(1-r^2_{13})^{\frac{1}{2}}} \cdot \frac{\sigma_1(1-r^2_{13})^{\frac{1}{2}}}{\sigma_2} = b_{12} - \frac{\Sigma x_1x_3}{N\sigma_1\sigma_3} \cdot \frac{\Sigma x_3x_2}{N\sigma_3\sigma_2} \cdot \frac{\sigma_1}{\sigma_2} = b_{12} - b_{13}b_{32}$$

different results from the classical procedure in the estimated values of x_1, the multiple correlation coefficient, and the slopes of the various regression lines, except for the case where the independent variables are uncorrelated.

(2) That the results of the graphic method are not in themselves consistent, but yield different estimated values of x_{1e}, indexes of multiple correlation and slopes of regression lines, if the order in which the independent variables are considered is changed.

A MODEL TO AID IN TEACHING PARTIAL CORRELATION

By Helen M. Walker and Walter N. Durost, *Teachers College, Columbia University*

One of the more difficult tasks in the teaching of elementary statistics is to build concepts, to imbue statistical formulas with concrete meaning for the beginner. Many persons not trained in mathematics and not able to think easily in abstract symbolism are now finding it necessary to have some acquaintance with the general method of statistics. Consequently any model which helps the beginner to comprehend the meaning of an important formula is worthy of attention.

The Data. The height, weight and age data for Glasgow school boys, gathered by Miss Ethel Elderton and published in Vol. X of *Biometrika*, were used in making the correlation model. The original form of these data proved less convenient than the redistribution made by Isserlis and reported in Vol. XI of *Biometrika*, so the latter was employed. Age levels 7 to 13 only were used.

The Construction. Seven plates of demi-plate glass approximately 8 by 20 inches, were built up in skyscraper fashion, each being separated from the other by four small rubber feet. Upon each plate the frequency distribution for the correlation between height and weight for a given age was plotted, using for the purpose Denison gummed numbers. The distribution was first plotted on a chart the size of the plate, then the glass plate was superimposed upon this chart, and the numbers placed over the proper cells as indicated through the glass. The regression lines, first drawn on the charts, were represented on the glass by narrow strips of passepartout tape, one color being used for the regression of height on weight and a different color for the regression of weight on height. The regression relative to age could not be shown on this model.

The distribution for the zero order r between height and weight was drawn on tracing cloth and this is used as the base on which the model rests. The intersection of the mean height and mean weight for the total group is represented on each plate by a cross in red, and the intersections of the means for each year group by a small star on the plate for that year.

The completed model is housed in a cabinet which has a false bottom of glass beneath which electric light bulbs have been placed, thus permitting the model to be seen under optimum conditions.

Partial and Zero Order Correlations. First of all, this model helps the beginner to visualize a three-way distribution of frequency, to see the

two-way distribution with which he has been working open out into a third dimension when measurement is made on a new variable. Thus it prepares him for the analytical consideration of problems dealing with many variables, bridging the gap between the two-dimensional scatter diagram of which he has complete graphical comprehension and the multi-variate regression problems which the student not trained in mathematics sometimes finds very puzzling.

The zero order correlation between height and weight is represented by a scatter diagram plotted on a sheet beneath the model, this scatter diagram showing the vertical projection of all the seven separate diagrams on one single plane. The zero order correlation between height and age could be represented by a horizontal projection of all the scores upon the narrow end of the cabinet and the zero order correlation between weight and age by a horizontal projection upon the longer side of the cabinet.

Upon each of the seven sheets of plate glass is the correlation distribution of height and weight for a single age group, and thus each one *approximates* the partial correlation between height and weight with age held constant. These correlations are of course not strictly uniform for the different ages, and therefore no one of them could be taken as identical with the partial correlation. Furthermore, in each section age varies slightly, within the narrow limits of one year, so for this reason also we cannot say that the correlations represented on the various sheets *are* the partial correlation, but only that they suggest and approximate it.

If vertical sections are taken through the mass at right angles to the weight axis, each being one weight-interval in width, each such section is seen to contain a distribution of the height and age for children of approximately uniform weight. Thus we get a picture suggesting the partial correlation between height and age when weight is constant. The partial correlation between weight and age with height held constant is suggested by taking vertical sections through the mass at right angles to the axis of height.

Standard Error of Estimate. The total mass may be thought of as cut into narrow slices first in one direction, then in another. Out of this we may select that portion of the mass common to a given height and a given weight. This will be a vertical column within which age varies freely, but within which the variation of height and weight is narrowly restricted to the width of their respective class intervals. Centering attention on the frequency in this column we get a suggestion of a frequency distribution in age with height and weight held constant. From this we pass readily to the concept of $\sigma_{a.hw}$. Of course the stu-

dent must be warned that the standard deviation of any single column is not identical with $\sigma_{a.hw}$ because (1) the distribution is not strictly homoscedastic and (2) variation in height and weight is not entirely eliminated within the column but only restricted. In the same way, $\sigma_{h.aw}$ may be given tangible meaning by centering attention on the distribution of frequency within a horizontal bar which is the intersection of one of the horizontal planes and a vertical slice perpendicular to the weight axis. This bar will extend in a direction parallel to the axis of height. In similar fashion $\sigma_{w.ah}$ can be suggested by the frequency distributions in horizontal bars parallel to the weight axis.

Regression Lines and Planes. For each age level, lines have been drawn to show the regression of height on weight and of weight on height. When the observer is in a favorable position, the seven lines for the regression of weight on height indicate a surface, the regression surface for predicting weight from height and age. This surface is not a plane, but is warped. If curved regression lines had been fitted on each plane, instead of lines drawn according to the usual straight line equation, there would have been a double warping. This would have given a more accurate picture of the real relationship, but not necessarily a better instrument for teaching. The regression surface for predicting height on the basis of weight and age is suggested by the seven separate regressions of height on weight. No way has been found to suggest either the third plane or any of the regression lines which involve age. The small stars which are placed at the intersection of the mean height and mean weight for each age fall very nearly on a straight line, which is the intersection of the two regression surfaces portrayed. The mean height and mean weight for the entire table is indicated by a small cross on each plate, the crosses lying in a vertical line. These two lines, the one vertical and the other oblique, intersect at a point where the third regression surface—if it could be shown—would cut the other two.

After these surfaces have been visualized, a truer concept of the standard error of estimate can be obtained in terms of the scattering of all the scores around the regression plane.

A CONSTRUCTIVE PROGRAM FOR PRICE STATISTICS

A technical conference on price statistics was held on September 25 and 26 at the Brookings Institution in Washington, arranged under the joint auspices of the section on Industry and Trade of the Social Science Research Council and of the Committee on Price Statistics of the American Statistical Association. The sponsoring bodies plan to use the recommendations of the conference as the basis for further development in this and in related fields. Criticism of the program outlined by the conference is urgently solicited.[1] The conference recommendations follow in full text.

THE RECOMMENDATIONS

The events of the last two years have brought home to economists and to the business men, to consumers and to the general public, the inadequacy of our existing knowledge of price movements in the United States. No comprehensive general index numbers of retail prices exist. No nation-wide study of budgets has been made since 1919, and as a result the utility of our cost of living index numbers is seriously impaired. Valuable work is being done in the field of wholesale prices, but inadequate funds, the dearth of representative price quotations for certain types of goods and other deficiencies have combined to prevent the development of index numbers yielding all the information currently required. As a consequence it has been impossible to trace accurately the price changes of recent years. This predicament is especially critical in view of the key function of prices in determining the direction and intensity of economic activity and in view of the increasing reliance upon statistical indicators in the development of commercial and public policy.

To the end that this condition may be corrected and that more adequate, more timely, more frequent and comprehensive information concerning price changes may be secured the following recommendations are submitted:

A. *Recommendations Concerning the Preparation of Index Numbers*

1. It is a function of the federal government to construct and with all possible promptness to publish comprehensive and scientifically constructed basic index numbers of wholesale and retail prices, and of living costs. However valuable the contributions of private agencies may be in these fields, it is a proper task of the central government to provide the basic index numbers required for economic and business purposes. Ample funds should be made available for the support of a permanent trained staff to carry on this work and to pursue the continuing research indispensable to its effective performance.
2. The official composite index numbers of wholesale prices and of retail prices should be constructed by a single governmental agency. The basic wholesale price indexes should be published or released as promptly as possible each month and, if possible, each week. If the basic index should prove impracticable on a weekly basis a supplementary index of wholesale prices should be prepared and released each week. The basic index of retail prices should be constructed on a monthly basis.
3. Index numbers of living costs should be constructed to represent the major economic groups in the community and to measure broad changes in national consumption. Such indexes should be published monthly, or at least quarterly. As a basis for accurate index numbers of living costs it is recom-

[1] Communications regarding the recommendations should be addressed to Meredith B. Givens, Secretary for Industry and Trade, Social Science Research Council, 230 Park Avenue, New York City.

mended that plans be made for a comprehensive study of family budgets to be conducted when normal consuming conditions have been restored. General surveys of family budgets among different classes of consumers must be conducted periodically if accurate index numbers of living costs are to be maintained.[1] Aside from their utility as measures of the position of the consumer in economic society, such indexes meet a variety of special needs in market analysis, in the adjustment of wages and prices, and in the interpretation of economic trends.

4. It is recommended that the official compiling agency should make full use of the technical knowledge and economic contacts of all branches of the government and of the services of various private price-compiling agencies in the development of the materials required for the construction of the basic index numbers. Accordingly, it is suggested that responsibility for the compilation and verification of individual price series should be placed upon the several governmental bodies most closely in contact with various fields of economic activity. In the construction of the official indexes it is urged that full use be made of adequately authenticated series compiled by private agencies.
5. The official index number of wholesale prices should be designed to serve as a general purpose index. To serve specific purposes it is desirable that group index numbers based upon various distinct principles of classification should also be constructed by the governmental agency engaged in this work. More numerous breakdowns are needed than are presented by the wholesale price indexes now available. No one principle of classification is adequate. The compiling and publishing agency should reconsider the breakdowns of the index numbers and as many of the important classifications or groups should be published as may prove practicable. Each of several bases of grouping the items should be employed to make separate breakdowns or separate sets of commodity groupings. This procedure will facilitate regrouping in a number of ways by the compiling agencies or by others. Further research is needed to determine what classifications are most practicable and useful. Among many possible principles in classification the following are suggested:
   a. A classification according to *source*.
      (For example, for farm products, animal products, mineral products and forest products.)
   b. A classification according to *use*.
      (For example, for producers' goods intended for use in capital equipment as distinct from consumers' goods intended for ultimate human consumption.)
   c. A classification according to stages of *manufacture* and *distribution*.
      (For example, for raw, semi-processed and finished goods.)
   d. A classification according to *industry*.
   e. A *geographical* classification.

   It is to be noted that some progress along the lines suggested above has been made.
6. In classifying commodities for the purpose of securing significant group index numbers every effort should be made to develop groups for which comparable data are available relating to volume of production, payrolls, number of employees and other important aspects of economic life. The comparability of price index number groupings and groupings of other statistical data for significant commodity groups and for important industries should add materially to the usefulness of all such measurements. Choice of base periods should be made in part with reference to the need for comparability between various series.

B. *Recommendations Concerning the Collection and Publication of Original Price Series*

1. In the compilation of individual price series certain standard modes of description should be employed and certain standard types of information should be

[1] The specific problems having to do with indexes of retail prices and of living costs are not fully dealt with here. Some of the general recommendations relate to such indexes, but a more complete program remains to be developed at another time. Detailed suggestions regarding the method and scope of a possible national survey of the cost of living are embodied in a special memorandum developed by the Social Science Research Council in 1929.

gathered. The requirements of exact description will vary from industry to industry and from commodity to commodity, but it is essential that certain minimum standards should be consistently maintained. The basic statistics should be made available in full and should be published by the compiling agency in as much detail as possible together with the weights used in the construction of the composites. Research and investigation should be undertaken to develop standard descriptions covering such points as the following:

a. Concerning the commodity:
   Exact definition of unit employed in price quotations.
   Chemical and physical description of standard graded commodities in as precise terms as possible.

b. Concerning the market:
   Geographical location.
   Economic character.
   (For example, producers', jobbers', wholesalers', or retailers' prices.)
   Exact stage in distribution represented by the quotations.
   (The economic character of the market will be defined in general if the economic functions of buyer and seller are accurately stated. If the market is an organized exchange that fact should be stated.)

c. Concerning the terms of sale:
   Such points as the following should be specifically covered in each case:
   (1) The price in units of value in which the transactions were made.
   (e.g., in cents, dollars, pounds sterling, gold dollars, greenbacks, etc.)
   (2) The statistical nature of the price.
   (e.g., a first of the month quotation, an average of daily quotations, etc.)
   (3) The economic character of the price.
   (e.g., contract or spot price, futures or "bought to arrive.")
   (4) Credit terms.
   (5) Delivery terms.
   (6) Inclusion or exclusion of duty.
   (Applicable to foreign items only.)

d. Concerning the volume of transactions represented by the quotations:
   (This information may not be available in all cases, but for certain classes of commodities it is essential.)

Continuing research is needed to develop uniform standards for adoption by all governmental price-compiling agencies. The above suggestions, which are by no means definitive, are put forward to indicate the type of information which should be available to facilitate the intelligent utilization of price data. Private organizations should be urged to follow the official practice in this field. Governmental bodies should endeavor to secure the adoption of uniform practices on the part of all agencies.

2. In the construction of price indexes a series of average sales realizations should not be used as a substitute for a series of quotations of actual prices except in cases where such realizations have reference to a simple uniform grade of a single commodity. The original price series used in the computation of index numbers should be made available in all cases, preferably in published form. When a number of price series relating to the same commodity are employed in an index all series relating to that commodity should also be combined as a special commodity price composite, constructed by using the same method of weighting employed in the general index provided the prices quoted represent similar conditions of sale, credit and delivery. (Dissimilar types of data, such as spot and future prices for wheat, should not be combined.) These individual composites should be published.

3. Price series for any commodity should be developed to represent the various geographical regions and types of markets. Commodities for which price series are compiled should represent each principal stage of fabrication and distribution. In the case of highly fabricated articles an attempt should be made to eliminate that part of each price change which is due to changes of design.

C. *Recommendations Concerning Needed Organization for Intensive Research*

In order to improve our knowledge of price movements and of price relations the above proposals should be put into practice, in so far as possible. This will require the prosecution of intensive, continuing and comprehensive research as an essential step toward the planning of necessary improvements. Information for all existing price series should be reviewed by a central agency with a view to discovering the gaps in existing price information and to stimulating the compilation of new series to round out the picture of the general price structure.

To this end it is recommended that the American Statistical Association and the Social Science Research Council should take steps toward the establishment of a permanent body for the planning and development of more adequate price statistics. To be effective such a body must be provided with funds. It should actively seek the coöperation of other interested organizations.

Among the possible functions of a continuing organization or permanent agency the following are suggested:

1. The sponsorship of certain types of research.
   a. A historical study of prices and the construction of more accurate long-time comparisons of the general price level.
   b. Special inquiries into such subjects as
      (1) The relations between prices of finished commodities and the prices of raw materials and fuels used in producing them.
      (2) The effect of tariff on prices.
      (3) The factors affecting the prices of by-products.
2. The listing and evaluation of existing original price series, commodity price composites, general and group price indexes and special purpose series such as those presented in public utility rate cases.
3. The experimental development of new index groupings and new weightings in such form that they could subsequently be taken over and kept up currently by other agencies.
4. The experimental collection of data in new fields.
5. The development and current revision of standard specifications in the field of price statistics.

It is understood that this document presents the point of view of the conferees as individuals and in no way involves the opinion of any organization aside from the conference itself.

(Signed) Robert W. Burgess, *Western Electric Company*
Morris A. Copeland, *University of Michigan*
J. Frederic Dewhurst, *Department of Commerce*
E. Dana Durand, *United States Tariff Commission*
Edward T. Frankel, *National Industrial Conference Board*
Meredith B. Givens, *Social Science Research Council*
Royal Meeker, *Index Number Institute, New Haven*
Frederick C. Mills, *National Bureau of Economic Research*
Paul H. Nystrom, *Columbia University*
Carl E. Parry, *Division of Research and Statistics, Federal Reserve Board.*
Malcolm C. Rorty, *American Founders Corporation, New York City*
W. Arthur Shelton, *United States Department of Agriculture*
O. C. Stine, *Bureau of Agricultural Economics*
A. W. Zelomek, *Fairchild Publications*

NOTATION OF COMMENTS AND EXCEPTIONS

The basic wholesale price index should be published or released as promptly as possible each month and, if possible, each week. (See recommendations, item A. 2.)

It is possible to construct a weekly basic index number of wholesale commodity prices. A good weekly index number of wholesale prices is not only useful but essential to current price analysis; therefore this point should be given more emphasis. The weekly index number series should indicate currently and ac-

curately the course of prices. It will be the more useful of the two in analyzing current situations, and will be useful in measuring variability and marking turning points in long-time price analysis.—O. C. Stine, *Bureau of Agricultural Economics.*

The Conference agreed that both weekly and monthly indexes of wholesale prices should be computed. Naturally this will lead to the *weekly* index becoming the *basic* index because it will be constructed first and the monthly index will be a combination of weekly indexes.—Royal Meeker, *Index Number Institute.*

The official composite index numbers of wholesale prices and of retail prices should be constructed by a single governmental agency. (See recommendations, item A. 2.)

I do not believe that the committee gave adequate consideration to questions involved in recommending that these two composite index numbers be constructed by a single agency. Obviously there might be some gain in comparability from having these two official index numbers constructed by a single agency, but why not also include the official composite index number of cost of living? The primary concern of the committee is to secure good composite index numbers rather than to indicate assignment or organization of activities in compiling data and constructing these index numbers.—O. C. Stine, *Bureau of Agricultural Economics.*

While I agree with many of the proposals contained in these recommendations, the document as a whole contains recommendations which owing to the time and expense required to accumulate the data would defeat the purposes of an index.—Ethelbert Stewart, *Commissioner of Labor Statistics, U. S. Department of Labor.*

THE PRICE LEVEL SLUMPS OF 1920 AND 1931—WHAT CAUSED THEM?

A dinner meeting of the American Statistical Association was held on Tuesday evening, October 27, 1931, at the Aldine Club, 200 Fifth Avenue, New York City. Four hundred and eighty-three persons were present.

The presiding officer was Dr. Roland P. Falkner, Chief Statistician of the National Industrial Conference Board. In introducing the presiding officer, the Secretary called attention to the remarkable advance which had taken place in statistical technique and economic problems since the time when Dr. Falkner prepared his well-known index numbers of prices. Attention was also called to the fact that these index numbers might well be thought of as initiating a new era in American statistics.

On account of illness, Carl Snyder, Statistician of the Federal Reserve Bank of New York, was unable to be present, hence the gist of the paper which he had prepared was presented by Dr. Warren M. Persons.

It was pointed out in Mr. Snyder's paper that, though we have had four business depressions of major severity since the Civil War, only two, namely those of 1921 and 1931, have been characterized by unusual declines in commodity price levels. During the present depression, indexes of commodity prices at wholesale have fallen between 30 and 40 per cent and the general price level of the Federal Reserve Bank of New York has declined by the unusual amount of 20 per cent.

It is a striking fact that neither the decline in 1920–1921 nor that in 1930–1931 shows any discoverable relationship to changes in the world's total stock of gold,

to changes in its stock of monetary gold, or to changes in its rate of gold production. Neither have these price declines shown any close approximation to the gold movement in or out of the United States.

Since the two crises have been so similar in character and apparent causation, the present depression cannot logically be ascribed to the general return of the nations to the gold standard, for, in 1920–1921, the United States was the only one of the larger nations truly on a gold standard. Although gold production was sharply curtailed during the World War, it has, since 1921, been nearly at pre-war volume. This has meant a steady increase in the total stock of gold which was obviously so super-abundant in the years preceding 1915 as to cause a steady rise in the general level of prices in gold-standard countries during the fifteen or twenty years preceding that date. Since 1921, the world's stock of monetary gold has increased at an average rate of about 4 per cent per annum, while basic production, and, therefore, presumably the manufactures and trade of the principal nations of the world, have been rising at an average rate of nearly 3 per cent, practically the same rate prevailing during the sixty or eighty years preceding the World War. There is, then, no apparent evidence of any "gold shortage."

In neither of these last two major crises has there been any apparent relationship between price declines in the United States and the gold movements in or out of this country. In 1918, after the lifting of the embargo, there was a heavy outflow of gold, but this was followed not by a fall in prices but by a violent rise in prices continuing for nearly a year thereafter. During the drastic price decline of 1920–1921, there was, on the other hand, a steady inflow of gold which replaced all the gold lost in 1918–1919 and much more in addition. Yet the fall in prices was the most violent that this country had known since the close of the Civil War.

In the same way, this country had, in 1927–1928, the heaviest loss of gold ever known to this or any other nation up to that time, and the discoverable effect upon prices in 1928 and the early part of 1929 was nearly nil. If we are to assume any direct relationship we must also assume that the effect of these gold movements is not felt for something like a year thereafter. This hypothesis seems improbable.

Furthermore, since the great fall in prices which began in the autumn of 1929, we have had, up to September, a well-nigh continuous inflow of gold but, thus far, it has had no discoverable tendency to check the price decline.

It is widely believed that the present world-wide depression and tremendous fall in prices has been closely related to the so-called maldistribution of gold, that is to the absorption by France and the United States of such a large fraction of the entire available supply. Here we meet with the remarkable paradox that while, in the United States, we have had the most violent fall in prices which we have known in peace times, and a depression that has perhaps exceeded all others in extent of duration, France has, until very recently, had no depression of any consequence and merely a moderate decline in prices—a decline which has affected the prices of their domestic products scarcely at all. This striking contrast is, indeed, one of the outstanding anomalies of the present depression and perhaps affords some clue as to its major cause or causes.

After reading Mr. Snyder's paper, Dr. Persons called attention to the influence of the tremendous amount of hoarding of money which has recently been going on in the United States and in other countries. In this country, it amounts to perhaps a billion or a billion and a half of dollars. Obviously these hoarded dollars are doing no money work. While, originally, hoarding was the effect of the depression, it has now become a causal factor of the first magnitude.

The speaker stressed the fact that, in this country, hoarding is entirely unnecessary, for, at the present time, securities and commodities can be purchased at bargain prices. Furthermore, the United States Postal Savings Banks furnish almost absolute safety for those who fear to risk their funds in other banks.

The second speaker of the evening was Professor Irving Fisher of Yale University. He pointed out that, since the United States is on a gold standard, the value of gold cannot be dissociated from the value of money and credit. The value of gold has increased recently mainly because the value of the dollar has gone up. In early times, most of our dollars consisted of gold or silver. Now, however, the majority of them are merely deposits in banks.

The fundamental cause of distress today is the over-indebtedness incurred by the American people two years or more ago. We went into debt for radios, automobiles, houses, and stocks. Our per capita debt in 1929 was probably the greatest in history. When the indebtedness was paid off, the volume of our deposit currency was thereby reduced. Whenever the debt structure within a nation is unduly inflated, it is likely to collapse like a house of cards. In 1929 it happened to be the Hatry failure which sent the cards tumbling.

Under ordinary conditions, we sell goods because of a high price. However, when the price level is falling, thousands of persons are forced to sell goods because of low prices. The lower the prices become, the more they are forced to sell. This phenomenon of "distress-selling" is one which is not adequately discussed in economic textbooks.

When prices fall sharply, people do not take advantage of the low prices to buy, the main reason being that they have no funds. Though the debtor sells and pays off part of his indebtedness, it often happens that he continually keeps getting deeper and deeper in debt, for the dollars which he owes are becoming more valuable. Thus, although England has been making payments on her indebtedness to the United States ever since 1925, it would now take 45 per cent more goods to pay off her debt than it would have done in 1925.

As debtors liquidate their debts, they decrease the amount of deposits and hence the amount of our circulating medium. The idea that liquidation should be allowed to go on to the bitter end is thoroughly unsound. It represents the philosophy of helplessness. Under no circumstances should the vicious spiral of Debt, Distress-selling, and Deflation, be allowed to continue until the depression wears itself out. The present situation cannot legitimately be considered as a normal corrective for the over-expansion of 1929. Our present situation is far more abnormal than that of 1929. Deflation and falling prices always breed trouble in a society managed by entrepreneurs, for when their profits turn to losses, they curtail their activities, thus producing unemployment, and this un-

employment reduces the national income. This fall in income makes prices fall still further.

Just as in 1919–1920, the Federal Reserve System has failed to protect the nation against a decline in prices. True, there has been put into circulation some $700,000,000, but this has not been enough. It came so late that hoarding had started and absorbed it all. There has been hesitation and, at present, efforts at stabilization have apparently been abandoned. Yet, it is unnecessary for the decline to continue further, for there are available at least two well-defined means of halting it. President Hoover has made an admirable beginning through his moratorium and his rediscount pool. The Federal Reserve System should, I believe, continue its open-market operations.

To eliminate this depression we need a rise in the price level. To raise the price level to normal and then keep it there should be the goal of our efforts.

The third speaker of the evening was Dr. Lionel D. Edie, Economist of the American Capital Corporation. He pointed out that deflation has its origin in inflation; that a certain amount of corrective deflation is desirable, but that destructive deflation, such as we have had with us during the last year, is demoralizing and has nothing to commend it.

The causes for the present depression may be classed as: (1) industrial, (2) political, (3) monetary. Under the first heading may be noted the fact that, in the case of a few staple commodities, there was over-production. Among the political causes may be mentioned excessive tariffs tending to interfere with the flow of international payments. Among monetary causes the most important was excessive lending. While these three causes, combined, doubtless made necessary a minor decline in prices and business activity, they did not necessitate the destructive phases which we have recently witnessed. These destructive phases have been caused by the sharp decline in the price level. This decline could have been stopped had the central banks of the world used their available powers to stamp out the conflagration. Their philosophy, however, has been "Let the fire burn itself out."

The important rôle played by the supply of money and circulating medium is clearly demonstrated by the similarity in the extent of the respective declines of the total volume of demand deposits outside speculative centers and the level of commodity prices at wholesale. This similarity is made more obvious when demand deposits (outside New York City) are adjusted in such a way as to eliminate the trend.

The supply of gold in the Treasury and in the Federal Reserve Banks has recently amounted to nearly $5,000,000,000. Only about $400,000,000 of this has been required to support that credit superstructure of member bank deposits outside New York City which, in the main, determines the price level, in other words, the deposit currency, which does nine-tenths of the money work of the nation. The remainder of this great gold reserve is used to back the hand-to-hand money which does but one-tenth of the total money work. The surest way to combat deflation is to shift gold from the use in which it is inefficient to the use in which it is highly efficient.

We are often told that depressions like the present one are necessary to wipe

out weak concerns. If we actually believe in complete liquidation, we should not follow the illogical practice of using government aid to protect weak concerns at a time like the present.

The truth is that destructive deflation is unnecessary. The central banks could have prevented this type of deflation by forcing larger reserves upon the member banks. The probabilities are that, if the central banks had used no more than $200,000,000 in gold at the right time and in the right place, they might have turned the price level upward.

There are two ways in which the deflation may be ended. First, by some accidental occurrence as, for example, war or crop shortage. Second, by deliberate action on the part of the authorities responsible for the credit facilities of the nation. The latter method is, of course, much more desirable and dependable. The organization of the National Credit Corporation is a step in the right direction. Nevertheless, since the plan for it has been announced, deposits have continued to shrink at a rate which, if continued, would amount to $4,000,000,000 per annum. It is by no means impossible that such a shrinkage may more than offset the amount of good done by the National Credit Corporation.

The probabilities are that if the central banks do not use their powers to stop the deflation movement, the more radical forces of the nation will institute their own measures for raising prices to higher levels, measures which may, in the end, lead to undue inflation and, therefore, be extremely dangerous.

The last speaker on the regular program was Professor Edwin W. Kemmerer of Princeton University. He pointed out that, between 1873 and 1897, the world was suffering from gold scarcity and that it was this gold shortage which caused the widespread demand for bi-metallism. The gold shortage was terminated by discoveries of this metal in the Klondike and South Africa. The influx of new gold from these regions caused wholesale prices to rise between 1897 and 1913 at a rate of about 2.6 per cent per annum. It was, however, between 1913 and 1920 that prices climbed very rapidly. This ascent happened at a time when gold production was actually falling off. Obviously, therefore, it was due to causes other than gold supply.

The two forces really responsible for it were, first, the establishment of the Federal Reserve System—a system which made the gold dollar in the United States do much more money work than before; second, the World War. The War's influence on the price level was due to the fact that, throughout a large part of the civilized world, paper money was substituted for gold. Furthermore, the velocity of the circulation of bank deposits increased greatly while the physical volume of business increased but slowly. In the United States we issued Liberty Bonds in great quantities and everyone was adjured to borrow and buy. The Federal Reserve banks loaned vast amounts of money on the security of these bonds, thus greatly increasing the total circulating medium. This large volume of credit resulted in inflated prices.

The price collapse in 1920 was due to the deflation of this credit balloon. This deflation was severe in the United States but was more disastrous in Europe.

The indications are that, in 1929, there was, in this country, no particular in-

flation in the prices of commodities in general. Had there been no war and had prices continued to increase from 1913 to 1929 at the pre-war rate of 2.6 per cent per annum, prices would have averaged about as high for the period 1922–1929 as they actually did.

Now, wholesale prices have again fallen to the 1913 level. This decline cannot legitimately be ascribed either to shortage of gold or to maldistribution of gold, for the world stock of monetary gold has increased at the average rate of about 3½ per cent per annum since 1921, which is faster than the normal annual rate of increase of physical productivity of basic commodities among advanced countries, calculated at 3 per cent by Carl Snyder. During these years of post-war readjustment the rate—this average rate of growth of physical productivity—fell well below this figure. As a matter of fact, it is not at all necessary that gold should increase as rapidly as business for it is perfectly feasible, through improved currency and banking devices and increasing rates of monetary and deposit turnover to make each ounce of gold do more and more money work.

If the recent price decline had been due to an insufficient supply of gold, it would doubtless have manifested itself by a slow downward trend rather than by a cataclysmic drop like that occurring in 1920 or like that of 1930–1931.

Furthermore, there is no particular reason to feel that the present price decline has been caused by an excessive accumulation of gold in the United States. True, we have a very large proportion of the total world supply but we need a large proportion because we transact an extremely large fraction of the business of the world. In proportion to the volume of business done, France now has much more gold than we have.

As a matter of fact, gold has flowed to the United States not because we wanted it, for it has come without any intent on our part. Our tariff policy is also partly responsible for our large gold holdings.

The principal reason why gold has flowed into the United States has, however, not been the tariff but the fact that many are following the policy of "safety first." People have been selling doubtful assets for what they would bring in terms of gold exchange and have sent the funds thus obtained to the United States or France where they believed that their money would be safe and that they could obtain gold whenever they desired it. Instead of encouraging gold to come to the United States, the Federal Reserve banks have actually discouraged the movement by keeping their rediscount rates low.

One of the main reasons why prices have fallen is that the velocity of circulation of demand deposits in our banks has diminished greatly. In 1929, for example, the actual rate of circulation in New York City was approximately 133; in August, 1931, it had been reduced to 36. When people expect prices to go lower, they tend to hoard not only money but bank deposits as well. As soon as confidence is restored, this hoarding process will doubtless stop and the velocity of circulation will increase rapidly. Our greatest need at the present time is a psychological one—a restoration of confidence. For the future it is to have the management of the currencies of the world placed in the hands of competent men; and to have these men coöperate in managing them in a scientific manner.

After the close of Professor Kemmerer's remarks, the meeting was opened for

general discussion. Dr. Woodlief Thomas expressed substantial agreement with the view of the speakers that the present depression was largely brought on by the growing volume of debt and the expansion in business and speculative activity which preceded. He stated that the method offered by most of the speakers for remedying the depression, namely the creation of more debt which would increase the purchasing power and hence prices, raised two questions: (1) Since the expansion of credit from 1922 to 1927 did not cause a rise in prices, what assurance have we that new expansion will result in such a rise? (2) What are the factors that cause credit to be used? There is at present no shortage of available banking resources. They are as large, if not larger, than they were in 1927 and 1928; yet the extent to which credit is used in business transactions is much smaller. Must there not be some motivation on the part of business men? New funds made available by reserve bank purchases of securities and through bonus payments to the veterans have been largely used in the first instance to buy government securities, and in the second instance to pay old debts. The rôle of volume of bank credit has been emphasized while the influence of velocity, which reflects the use that is made of credit, has been ignored.

The discussion was closed by Professor Schulze-Gävernitz of the Universities of Freiburg and Berlin. He expressed the view that, while we have used the brains which God has given us in the natural sciences, we have made but little use of them in the social sciences, and that this is especially true in the fields of currency and credit. In his opinion, the world depression was by no means inevitable, but could have been avoided had appropriate action been taken by the proper authorities.

However, it is no use to worry about the past. The important question is what to do now. Obviously, in times like the present, when confidence is lacking, it does no good to lower interest rates, for those who have proper security will not borrow and those who do not have it cannot borrow. Under such circumstances, we need to use more drastic remedies. The easiest remedial measure is to reduce the purchasing power of money, in other words, to increase commodity prices. This can be done in the United States without destroying the gold standard, for the United States has, at present, abundant gold reserves. Eventually, doubtless, the gold standard is destined to disappear, but the time is not yet ripe for that. For the present emergency, the great thing is to create additional purchasing power by means of currency.

Radical action to eliminate unemployment is imperative. Public relief is better than nothing but public employment is much better than public relief. This public employment might be the way to bring more money into circulation, thus overcoming deflation.

To illustrate how desperate the condition has become in Europe, the speaker quoted Montague Norman, Governor of the Bank of England, as saying that if the present depression is not overcome within a year, capitalism may be wiped out. Europe is not now strong enough to turn the tide. America is in far better position to take the lead.

The meeting adjourned.

WILLFORD I. KING, *Secretary*

FINANCIAL LIQUIDATION AND RECOVERY

A dinner meeting of the American Statistical Association was held on Tuesday, November 24, 1931, at the Aldine Club, 200 Fifth Avenue, New York City. Three hundred and twenty persons were in attendance. Dr. W. Randolph Burgess, Deputy Governor of the Federal Reserve Bank of New York, presided. The general topic under discussion was "Financial Liquidation and Recovery."

The first speaker of the evening was Mr. John E. Rovensky, Vice-Chairman of the Bank of America, who spoke on "Some of the Proposed Changes in Our Financial Machinery." Mr. Rovensky called attention to the fact that every crisis brings forth a great number of financial doctors, and a correspondingly long list of proposed remedies, many of them entirely unsound, and most of them so radical that their application would result in a greater degree of maladjustment than that from which our economic organization is now suffering.

Mr. Rovensky expressed the view that there is no rapid cure for our fundamental trouble—the feeling of poverty which so generally prevails throughout our country, and which persists in spite of the fact that people are still in possession of the same material goods as formerly.

He also stated that, in his opinion, the proposal to find a corrective in our present situation in drastic changes in the Federal Reserve System would be a step in the wrong direction, although he felt that some slight broadening of the Federal Reserve Act might be effected without harm. This, however, he held might be accomplished more safely through the regulations of the Federal Reserve Board, than through legislative action which might open the way to dangerous tampering with the Act.

Some legitimate needs of our financial machinery, Mr. Rovensky stated, had been indicated by recent developments, but he felt that remedies for such ills should be sought outside the banks of issue. Our banking machinery probably ought to include some recognition of security or Lombard loans, and also of real estate loans.

President Hoover's plan for aiding banks holding a large percentage of real estate loans, through the formation of twelve regional Home Loan Discount Banks, in Mr. Rovensky's opinion, has much to commend it. An alternative plan, he stated, might be the utilization of existing Federal Land Banks for the same purpose. In any circumstances, the system should be so managed that it would not become an outlet or dumping ground for large amounts of immobile real estate loans.

"In the field of security or Lombard loans," Mr. Rovensky continued, "the National Credit Corporation gives every indication of being the agency that will meet most of the important requirements of the present situation. I hope that it will develop into a permanent part of our banking structure, a sort of national clearing house association, which, by pooling the resources of associated banks would, in time of special need, mobilize this credit which is not and ought not to be eligible for rediscount with the Federal Reserve Banks."

The second speaker of the evening was Dr. Warren M. Persons, Consulting Economist of Standard Statistics and other industrial and financial companies.

He began his remarks by pointing out that both debtors and creditors have lost heavily during the last two years. It is not surprising, therefore, that many individuals have felt it desirable, in view of numerous bank suspensions and the prospect of other ones, to accumulate as much cash as possible, and to put this cash into their safe deposit boxes. The individual, whether a person, corporation or bank, is nearly helpless in the face of the conditions which have arisen. We must act coöperatively or through the government if we are to break the evil spiral of deflation.

Those suggesting remedies for the depression may, like medical men, be divided into homeopaths and allopaths. The former contend that "like cures like," and hence that the remedy for deflation is more deflation, for unemployment is more unemployment, for liquidation is more liquidation. This school of thinkers, holding that we are the helpless victims of an economic machine which we are powerless to control, believes that we must either let the depression work itself out to its inevitable end, or adopt means to accelerate liquidation.

Dr. Persons definitely aligned himself with the allopaths. He held that much can be done to lift us out of the depression. Among the measures which he considers necessary are the following:

1. To adopt an enlightened treatment of those foreigners who are indebted to us on private or governmental account.
2. To adjust our tariff in such a way as to enable foreign debtors to pay us in goods, would contribute to our interests as well as to those of our debtors.
3. To attack directly the prevailing lack of confidence by suggesting safe or profitable uses for funds on hand.
4. To attack the causes of lack of confidence intelligently, vigorously, and in good faith.
5. To prevail upon the banks and the Federal Reserve System to coöperate in utilizing currency retained by hoarders as a basis for expanding the volume of credit. This can be done without going off of the gold base. Abandonment of the gold standard is dangerous because it might lead to extreme inflation and, should this happen, the remedy might be worse than the disease. Some inflation, however, when one has a flat tire, is necessary if the business vehicle is to proceed on its journey. Under these circumstances no obnoxious meaning should be attached to the word.

The third speaker of the evening was Mr. Robert B. Warren, of Case, Pomeroy, and Company. His topic was "After the Gold Exchange Standard, What?" Mr. Warren pointed out that it is difficult to find an instance in which a nation constantly on the gold standard has experienced price fluctuations as great as those occurring in the United States during the last seventeen years. One of the most important factors affecting the price situation during recent months has been the collapse of the gold exchange standard, the standard which, after 1922, became the basis of a large part of the currency of the world.

Previous to the great War, money was essentially gold coin or gold certificates, accompanied by a larger or smaller fiduciary issue. The central banks had functions which were decidedly limited. The chief reason for allowing them to

issue bank notes was to save the trouble of carrying about gold coin, to regulate the flow of international funds, and to provide a measure of elasticity in seasonal or cyclical periods of strain.

The gold exchange standard in Europe originated primarily at the Genoa Conference which recommended the system as a means of economizing in the use of gold. The essential feature of the gold exchange standard was that central banks were permitted to count as gold reserves their balances held in the banks of nations actually on a gold or gold bullion standard as, for example, in the banks of the United States or Great Britain. The result of this arrangement was to make possible an enormous expansion in the volume of currency, and to cause a concentration of international demand liabilities in such gold centers. Under this arrangement it was possible for one dollar of gold in the Federal Reserve Bank of New York to cover as much as $720 in foreign deposit currency. The late Governor Benjamin Strong referred facetiously to it as a "gold tipped standard."

One of the chief weaknesses of the gold exchange standard was that responsibility for its maintenance was never definitely allocated or recognized. The banks of London, for example, never gathered reserves adequate to cover the demand deposits of foreign central banks. These demand deposits grew to huge amounts. For example, in 1927, the Bank of France alone was in a position to call upon the London market for an amount in gold probably equal to the entire gold stocks of England, and several times the actual gold in the banking department of the Bank of England. When, a few months ago, the foreign banks began to draw upon London, the British banks were unable to meet the strain, and Great Britain was, therefore, compelled to abandon the gold standard. This abandonment automatically placed a large part of the world upon a paper standard. The probabilities are that the gold exchange standard is now dead.

The world requires a common international standard. A number of countries are now talking seriously of establishing managed currency. There is, however, little prospect of the world's accepting such an international standard of value. It is impossible to go back to the true gold standard, for many countries do not have a large enough gold supply to make this feasible; but, with a different distribution of gold stocks, an international gold bullion standard might be practicable. In the event this proves impossible, it might be advisable to make silver once again part of the basic money of the world by the adoption of international bi-metalism or symmetalism. The advantage of adopting such a broad metallic base would be to make paper money once more redeemable in precious metal on demand, which is impossible under the gold bullion standard.

The fourth regular speaker of the evening was Alexander Sachs, Economist and Director of the Lehman Corporation, who dealt with the topic "The Rôle and Responsibility of Academic Delusion in the Depression."

Mr. Sachs began by pointing out that, during the period immediately preceding the crash, statistical economists had been placing undue stress upon interest rates and monetary factors as being the primary determinants of the business cycle. In 1929, for example, it was the general opinion that the Federal Reserve System had discovered and was putting into effect a satisfactory method of eliminating extreme cyclical movements. It was also widely believed that low

interest rates could be depended upon to stimulate business activities. The result was almost universal confidence that no serious depression was likely to occur in the immediate future.

There was also a strong tendency among statisticians to put their trust in trend lines. Unfortunately, they overlooked the fact that many of the upward trends were the effects of a period of abnormal growth characterizing new industries. The fact that the products of these new industries such as, for example, automobiles, tires, refrigerators, etc., were being improved in such a manner as to give a steady increase in durability was too commonly overlooked, and hence it was not realized that, in the near future, we would inevitably meet with a falling demand for these products. Furthermore, little note was taken of the fact that the railroad industry was being undermined by the construction of cross-country gas mains, high power electric lines, and concrete highways. Under the circumstances, it is not surprising that most of the predictions went wrong.

Mr. Sachs expressed the further opinion that had statisticians and economists devoted more attention to the physical and technical phases of industry they would not have been so optimistic and would not have expected a revival of business early in 1930. Had they understood the real situation during the boom, they would have insisted on the building up of reserves and, when depression began, they would have urged the speeding up, rather than the postponement, of liquidation.

The last regular speaker on the program was Mr. Dwight C. Rose, Investment Counsellor, who dealt with the subject "Common Stocks at the Current Price Level." He opened by calling attention to the fact that, in December, 1928, at a meeting of the American Statistical Association, he analyzed several major factors influencing the price level of common stocks. From a consideration of these factors at that time, he concluded that, unless we were confronted with an entirely new set of conditions that no one could understand or explain on the basis of past experience, the then current level was dangerously high, and investors purchasing stocks at that time stood to lose anywhere up to 50 per cent of their purchase price.

Mr. Rose continued by pointing out that, first, last, and all the time, the market prices of common stocks are fundamentally dependent upon normal or prospective earnings, so we must look primarily to higher earnings in the future to justify higher stock prices. If earnings become lower instead of higher we must expect to see lower stock prices.

An analysis of the same factors discussed three years ago leads to the following suggestions:

1. On the generally recognized assumption that changing interest rates and changing commodity prices are directly reflected in the price level of common stocks, the threat which these two factors have offered to lower stock prices ever since the War has now been largely removed.
2. Over a long period of years, the most important factor influencing the price level of common stocks has been the accumulated earnings plowed back to

expand or improve the productive facilities of corporations. But these expanded productive facilities cannot, in this depressed period, find a market for their increased capacity. If, however, the capitalistic system continues essentially as we have known it in the past, it is reasonable to anticipate that the inherent characteristic of the people of the world to strive to maintain and improve their standard of living will again assert itself in a restoration of the *volume* of demand for goods and services sufficient to utilize most of the productive facilities that have been developed in this country over the past 31 years.

3. An increased volume of production, however, cannot by itself provide increased corporate earnings; the prices at which those products are sold also have a primary influence on earnings.

   If industrial common stocks were worth approximately the prices for which they were selling in 1901, the compound effect of actual earnings plowed back would have been to increase their equity value from 100 in 1901 to 630 in 1931.

   If we chose to deflate these reinvested earnings to 1901 commodity prices (the lowest level reached throughout the 31 years), the equity in our industrial stocks would have been increased to only 330. If, however, we conclude that commodity prices are more likely to become stabilized around current levels (approximately the level of 1913) the reflection of reinvested earnings deflated to 1913 commodity prices would result in a present equity value in our industrial stocks of 450, as compared with a current market price of about 270.

Perhaps a conservative suggestion would be that, as we pass through the revival stage of this cycle, we should have a restoration of demand for goods at approximately the present level of commodity prices. If this were reflected in common stock prices, it would mean an appreciation of more than 50 per cent from present levels, although they may, of course, continue lower in the meantime. If and when we enter the expansion stage after this revival, a further appreciation of 50 per cent might be anticipated, making a total appreciation above present prices of approximately 125 per cent.

The discussion was led by Mr. Sherwin C. Badger, of Barron's Magazine. He questioned the validity of the theory that deflation consists of a never-ending downward spiral in which each new adjustment creates the necessity for other adjustments. He cited as an encouraging sign the fact that wholesale commodity prices had been held fairly steady for several months which suggested that perhaps deflation in that particular area had been about completed. The question arose, he said, as to whether we should attempt by some broad plan to restore public confidence rather than to concentrate on removing or correcting the factors which were causing lack of confidence.

There is some doubt whether confidence can be restored until the basic causes for non-confidence have been remedied. The best policy is to face the real issues that concern us. We need drastic action in connection with international payments and reparations and the system of tariff walls which have been built up

between the nations and which are still rising. We cannot afford to ignore our public debt.

He cited, as an example, the wholesale manner in which public borrowing has gone on to build an enormous system of highways, regardless of the economic return, and pointed out that in the course of this construction we had built up a competitor of the railroads which was wrecking one of our largest and most stable industries.

The discussion was continued by Mr. Vicker. He held that the first essential in getting out of the depression was to allay existing fear. To do this, our financial institutions must be put on sound bases. They could be greatly helped if all reparations and war debts were to be wiped off the slate.

At this point, Mr. Fales stated that he felt there was entirely too much tendency to charge our ills to the reparations question and to forget that France had good reason for demanding that Germany pay her debts. He also pointed out that what Germany has actually done to date has been to borrow, from the United States and elsewhere, all the money that she has paid out.

The meeting adjourned.

WILLFORD I. KING, *Secretary*

PROGRESS OF WORK IN THE CENSUS BUREAU

LIMITING THE EDITION OF CENSUS REPORTS

The Bureau has now entered upon the last year of the three-year census period which began on January 1, 1930,[1] and will therefore terminate on December 31, 1932. Of the $39,000,000 appropriated to cover the cost of the Fifteenth Census and that of the current work of the Census Bureau during the census period, only about $5,000,000 remained unexpended on the first of January. A short time before that a careful estimate had been made of the cost of printing 1,000 copies each of the reports and bulletins that were still to be published and the total reached the tidy sum of $1,075,000. In view of this situation it may prove necessary to limit the editions of all census publications from now on to the 1,000 copies provided for in the estimate above referred to. This will be hardly more than sufficient to supply the principal public and university or college libraries in the United States.

Additional copies of each report or bulletin will be printed for sale by the Superintendent of Documents, the Bureau itself not being allowed to sell its publications. The price which the Superintendent of Documents places upon the census publications is hardly more than enough to cover cost of press work, paper, and binding. For the final reports it will range probably from $2.00 to $3.00 a volume depending of course upon the number of pages.

This necessity of limiting the size of the editions printed by the Bureau for gratuitous distribution results from the fact that after the estimates for the appropriations were made and approved the scope of the work of the Bureau was considerably extended, particularly by the addition of unemployment to the

[1] Erroneously stated as July 1, 1929, in the December issue of this JOURNAL (p. 466).

subjects covered by the main census and by the special census of unemployment which was taken in January, 1931.

Eight series of state bulletins or reports covering the following subjects have already been completed and printed: (1) Population, minor civil divisions; (2) Population, composition and characteristics; (3) Unemployment; (4) Agriculture, minor civil divisions; (5) Agriculture, detail by counties, first series and (6) second series; (7) Irrigation; and (8) Drainage. Fairly large editions of these bulletins were printed and the supply on hand will probably be sufficient to answer all reasonable demands for these publications.

The series of state bulletins not yet completed—some of them in fact hardly more than begun—include the one on occupations, the one on families, the one on "type of farm," three on the census of distribution covering respectively wholesale trade, retail trade, and construction, and the one on manufactures. The reports of the census of manufactures include also a series of industry reports now in process of publication.

CENSUS OF RELIEF EXPENDITURES

The Bureau of the Census with the assistance of the United States Children's Bureau and the Department of Statistics of the Russell Sage Foundation recently completed a compilation of statistics on relief extended to families outside of institutions and to homeless men by governmental and private organizations in cities and other incorporated places, and also by county governments. This inquiry, which was undertaken at the request and under the auspices of the President's Organization on Unemployment Relief, covered the first three months of the year 1929 and the first three months of the year 1931. Since the earlier period was one in which industrial conditions were good, while the later period represented probably the peak relief load for any three-month period up to the time when the inquiry was begun in August, 1931, it was believed that the increase would furnish a basis for estimating the amount of relief chargeable to the business depression in the areas and for the period covered by the inquiry.

The inquiry did not cover relief given by fraternal organizations, individual church organizations, or welfare departments of industries. Nor did it cover relief by individual schools or school relief unless it represented a considerable share of the total relief in the community. Otherwise it covered all relief by governmental or private organizations, except that the figures for counties included only the relief extended by the county governments.

Returns were received from all of the 93 cities of 100,000 inhabitants or more; from all but one of the 217 cities of from 30,000 to 100,000; from 4,863 out of 5,938 cities or incorporated places of from 1,000 to 30,000; and from 6,353 smaller incorporated places.

The cities and other incorporated places from which reports were received comprise 89.2 per cent of the total population living in cities and incorporated places and 57.4 per cent of the total population of the United States.

The expenditures for relief in the incorporated places for which reports were received, together with the relief expenditures by county governments as re-

ported, increased from $22,338,144 during the first three months of 1929 to $73,757,300 during the same months of 1931, an increase of 230 per cent.

MOVING TO NEW DEPARTMENT BUILDING

The new building for the Department of Commerce, designed to accommodate all the Bureaus in the Department with the exception of the Bureau of Standards, has been completed and was ready for occupancy on the first of January. Three divisions of the Census Bureau—the Division of Vital Statistics, that of Financial Statistics of Cities, and the Geographer's Division—have moved into the new building, but the other divisions, including all those engaged mainly on Fifteenth Census work, and also the administrative division, which includes the offices of the Director, Assistant Director, and Chief Clerk, will remain in their present temporary quarters for some months to come and possibly until the end of the current year.

J. A. H.

MISCELLANEOUS NOTES

Error in the December, 1931, Issue.—The Officers' Page, as printed in the December, 1931, issue consisted of the official list as of December, 1930. The correct list of officers will be found in the September, 1931, issue of this JOURNAL, and also in the 1932 issue of the *Proceedings of the American Statistical Association.*

The error occurred at the Press after all proof had been read both by the Editorial Office and the printer, and consisted of the substitution of the wrong page at the time that the forms were locked. This was discovered only after the entire issue had been mailed.—THE EDITOR.

The Albany Chapter.—The Albany Chapter of the American Statistical Association has organized two classes in elementary statistics, primarily for the benefit of Civil Service employees. The total enrollment is 92. These classes are given under the auspices of the Chapter by Mr. Sidney W. Wilcox, Chief Statistician of the New York State Department of Labor, formerly Professor of Statistics at the University of Pittsburgh.

The last dinner meeting of the Chapter was held on December 9, 1931, at which meeting Miss Clara Parsons of the New York State Department of Correction presented a paper entitled "Fingerprints," and Mr. Frank Leonard, also of the New York State Department of Correction, talked on "Program of the Department of Correction in Respect to Criminal Statistics."

The Boston Chapter.—A joint meeting of the Boston Chapters of the American Statistical Association and the National Association of Cost Accountants was held at the Boston Chamber of Commerce on Wednesday evening, December 16, 1931. Dinner was served at 6.30 P.M. There were 122 members and guests present at the dinner, and 222 at the speaking session.

Mr. Leroy D. Peavey, President of the Boston Chapter of the American Statistical Association, presided.

Dr. David Friday, Consulting Economist, Washington, D. C., was the first speaker, and the subject of his address was "Economic Changes in the Present Financial Readjustment." His greatest emphasis was on the need for the investigation of our

financial structure. He pointed to the failure of some 9,000 banks since the end of the War in striking contrast with the few failures prewar when banks were earning in the neighborhood of 7½ per cent. Most of these banks were located in the West and South. The decline in prices, particularly land values, and the reduced importance of farming with the consequent decline in farm products, etc., was pointed out as the principal cause of these failures. Dr. Friday referred to the extraordinary similarity of price curves in each of the three principal postwar booms—following the Napoleonic, the Civil, and the World War.

He analyzed the changes in land values, the shift into suburban areas at the cost of more central locations, and made a hopeful comment on the urgent necessity for expansive reorganization of traffic facilities in the large cities. As to the railroads, as soon as traffic comes back in any appreciable volume they will make big profits, so Dr. Friday maintained. Increased efficiency has enabled the railroads to handle a larger volume of traffic with steadily declining personnel, 1920–1929; also, rail rates went down where the earnings went up. Air travel he did not consider to be a serious menace to the older forms of transport.

Looking abroad, Dr. Friday expressed his admiration for the British economists and maintained that they were the only ones who might make a success of managed currency for not only Great Britain, but the British Empire—an integrating financial unit for the Empire as a whole. Colonies, he maintained, were of no economic advantage to a country. Germany's adaptation of American production methods assured her future. At the foundation she is economically sound. The Russian bogie fails to alarm him. He figures that at best in 25 years they will not attain to a standard of living which could be rated more than 50 per cent of ours. War debts will be scaled down, if not cancelled. Figuring his share at $3.30, Dr. Friday said he would gladly forego that amount.

Mr. Joseph H. Barber of Boston discussed the topic, "The Arithmetic of Business Values." A summary of his address follows.

After all, essential needs and truths are always simple. It may help a little to set down some of these simple truths.

1. *You can't add* excess production to deficient demand without getting declining price valuations. Two years ago, we began to suspect this. Only today, after prices have fallen one-third, have we believed it enough to get production sufficiently down. Only in the fourth quarter of 1931 have we generally balanced current production against current effective demand and begun to reduce primary stocks on hand.

2. *You can't subtract* 101 cents from $1.00 and have any profit value left. In business it is net profit that is first to go. The net profit portion cannot be retained unless all the other parts are budgeted to their proper "number of cents" relationship to the total.

3. *You can't multiply* the same 25 per cent profit margin against a 33 per cent lower price level, and get the same dollars of income to cover overhead. Most managers are surprised when they inspect the ratio width of their current profit margin, to discover that its percentage to sales is practically as great as in 1928 and 1929. If their usual profit margin then was 25 per cent of sales, and if their margin is still 25 per cent of sales, then their margin is as wide now as can be hoped for in the future. Granted that price levels have declined roughly one-third, it must necessarily follow that the dollars of income for overheads will be reduced one-third.

In the face of this revised valuation for overhead allowances, there must be a definite readjustment of corporation overheads. Either (1) the individual salaries and expenses of the former personnel must be reduced 33 per cent, or (2) the personnel structure must be deflated by 33 per cent through eliminations, or (3) both individual

salaries and the personnel structure must be deflated to result in a combined *net* saving of 33 per cent.

4. *You can't divide* 360 billion dollars of wealth into equal portions of a 5 billion dollar cash fund, without crashing valuations to 1/72 of their former valuations. The country's wealth itself comprises values. Most of those values are represented by sheets of paper—such as mortgages, bonds, stocks and commercial paper. While the valuations written upon these papers are expressed in terms of cash, the values themselves are intangible and normally rest upon a foundation of confidence.

In 1929 the country had roughly 360 billion dollars in wealth, as against only 5 billions in cash. Fear began to demand its pound of flesh. It wanted to see all its rights converted into cash. It demanded that 360 billion dollars of wealth become tangibly incarnated in the form of cash. But, since there is only a 5 billion dollar cash fund, complete liquidation into cash could only come about by crashing valuations down to only 1/72 of the former valuations. For many corporations, their full outstanding stock now has a quoted value no more than their actual cash. If the same processes continue as far in other economic matters, we would reach the limit of bread at 1 cent a loaf, shoes at 20 cents a pair, and coal at 50 cents a ton.

What has the Individual Manager Learned from Depression? In most businesses the net working capital equals only three months sales. This means that, during a period of stress, the working capital may be seriously impaired within six months. As a consequence, in a depression a business man is forced to look to the immediate future, and cannot personally attach very great weight to programs that do not promise speedy results.

The noted economist Wesley Mitchell has said that "the only normal condition of business is a constant state of change." The individual manager realizes this fully; and, as a consequence, he not only watches his working capital with an "eagle eye," but more particularly he watches the *changes* in his working capital. If he doesn't set himself up as the perpetual spy upon his working capital position, then he will soon find himself replaced and someone else will be watching it for him.

Finally, since the changes in working capital are all too quickly reflected in cash position, an individual's security depends upon his maintaining a liquid supply of cold cash.

Following the addresses by Dr. Friday and Mr. Barber, the meeting was open for discussion, in which a large number of those present participated. The meeting adjourned at 10.45 P.M.

ROSWELL F. PHELPS, *Secretary*

The Chicago Chapter.—On November 19, 1931, at the second dinner meeting of the season, with 55 in attendance, Mr. George E. Putnam, Manager of the Commercial Research Department of Swift and Company, spoke on the topic "What Can We Do About Depression? Is National Planning the Remedy?" Mr. Putnam outlined three causal doctrines for depression and the remedies that have been proposed: (1) Lack of business leadership, or inability to coördinate production and consumption. The remedy proposed is National Planning, but Mr. Putnam believes such planning could not be successfully operated under our present system of private enterprise. (2) Lack of leadership for uses of products; workers do not have sufficient purchasing power to buy products of industry, owing largely to profits taken by leaders. As a remedy for this, maintenance of wages, new building, etc., have been proposed, to create purchasing power. It was pointed out, however, that recent efforts along these lines have been failures. (3) Lack of credit control by the Federal Reserve System. But Mr. Putnam explained that the Federal Reserve has only

been following rules of national policy, i.e., wanting war debts paid but no foreign goods. As a consequence, we are bound to get gold and promissory notes, thus breaking down foreign credit. We have done more than any other country to force other countries off the gold standard, and we now have no export market for our products. Mr. Putnam believes that the immediate cause for all depressions is to be found in human beings and their use of credit; when the supply of credit runs short, trouble starts. His remedy for depression would be a Supreme Economic Council for determining matters of national policy.

BERNICE LAMB, *Secretary*

The Cleveland Chapter.—The second meeting of the season was held on October 19. Mr. Russell Weisman of the Cleveland Plain Dealer gave a talk on bi-metallism in which he sketched the history of bi-metallism in this country and discussed what would probably happen if a bi-metallic system were set up in the United States at the present time.

The next meeting was on November 16. Colonel Leonard Ayres of the Cleveland Trust Company gave a talk on the business situation and on business prospects for next year.

The next meeting was on November 23. The Harvard Economic Conference was reviewed by the members who had been present, the discussion being led by Mr. Bradford B. Smith of the Cleveland Trust Company.

The fifth meeting took place on December 21. The address was given by Professor McPherson of Cleveland College, the subject being the German situation and outlook. Professor McPherson was in Germany during the summer of 1931.

D. C. ELLIOTT, *Secretary*

The Pittsburgh Chapter.—Throughout the year 1931 intensive interest has been shown at the monthly luncheon meetings at the Keystone Athletic Club. An average of 32 members was in attendance and the trend seems to be upward.

The 12-months group forecast, based on the Annalist Index of General Business Activity, is revised monthly and a new month added. Following the announcement of the revised figures the members are invited to recite their method of reasoning in making up the individual forecasts. Considerable benefit has been derived from this feature of the meetings as it is sure to bring out all phases of the business picture.

At the October 22 meeting Dr. George K. McCabe and Mr. Prentice N. Dean of the Finance Department of the University of Pittsburgh contributed by speaking on the causes and effects of the abandonment of the gold standard in England. The November 25 meeting was featured by Mr. A. C. Robinson, President, Peoples-Pittsburgh Trust Company, who spoke on the events leading up to the organization of the National Credit Corporation, and the functions and purpose of that institution. Mr. J. C. Nevin, Managing Director of the Pittsburgh Branch of the Federal Reserve Bank of Cleveland and Vice-President of the Pittsburgh Chapter, answered questions on the subject.

The speaker at the December 17 meeting was Mr. E. C. Stone, Assistant to the President, Philadelphia Company, who selected as his subject the timely question—"What Next?" Mr. Stone recently has been making a study of contemporaneous economic conditions, which has brought forth numerous tentative conclusions, and which were discussed fully. The key to these conclusions was as follows:

1. When the demand for goods and services becomes sufficiently urgent, the trend of business will turn upward.

2. As a foundation upon which increased demands will be built to create better business, the price levels in commodities, bonds, stocks and wages must be stabilized.
3. As time goes on substantial demands are building up through the operation of the factors of depreciation and obsolescence on existing fixed capital and through the progress of engineering development.
4. Increased demands from the people at large in any substantial volume cannot be expected under existing conditions.
5. Adequate information is not available upon which to base an opinion as to when the trend of business will turn upward.
6. Bank credit is a very powerful economic instrument about which there is yet much to be learned.

Subjects for future meetings have been tentatively announced by the Program Committee as follows: The Movement of Wholesale and Retail Prices; Plans for Stabilizing the Coal Industry; Merchandising the Business Cycle.

A. W. LOHR, *Assistant Secretary*

Philadelphia Statistics Group.—Two meetings of the Philadelphia Statistics Group were held during the fall and early winter. At a dinner meeting in November the topic, "The Financial Crises Abroad and Their Effects in the United States," was discussed. Robert B. Warren of Case, Pomeroy and Company, New York, talked on the financial situation in England, and Dr. Ralph Young of the Economics Department, Wharton School, University of Pennsylvania, traced the development of the crisis in Germany.

In December a symposium was held on methods of unemployment relief in Philadelphia. The speakers on this program, together with their special topics, were: Dr. W. N. Loucks, Assistant Professor of Economics, Wharton School, "Relief Through Public Works"; Emmett H. Welch, Unemployment Studies, Industrial Research Department, "Displacing Employed Married Women"; Roger F. Evans, Leeds and Northrup Company, "Prevention and Relief Through Individual Company Action"; Karl de Schweinitz, Executive Secretary, Community Council of Philadelphia, "Problem of Direct Relief: Public vs. Private."

The meetings of the Philadelphia Statistics Group are held on call at the Christian Association Building, University of Pennsylvania.

H. S. DAVIS

United States Bureau of Labor Statistics.—In January, 1932, the Bureau began the publication of a revised wholesale price index, which is being issued weekly as well as monthly. The new index carries 784 price entries, instead of 550 as before. For the most part, the additional items are the fully manufactured commodities, or the so-called "consumers' goods." The average for the year 1926 is continued as the price base, or 100, and all additional commodities have been priced back to that date. The monthly index is being computed separately as heretofore, but on the larger number of commodities, and is not an average of the weekly indexes.

A field study of relative costs of material and labor in building construction in several representative cities in the United States is now being made, the data being taken directly from the records of building contractors. The report will be similar to that issued by the Bureau on this subject early in 1929 for three cities. By correlating the data obtained in the present study with building permit figures, union wage rates in the building trades, and wholesale cost of building material, it will be possible to arrive at a fairly satisfactory index of building costs.

The results of the investigation of technological changes in the cigar industry and their effects upon employment, referred to in a previous issue of this JOURNAL, were published in the December, 1931, *Monthly Labor Review*. Similar studies are in progress for the telephone and telegraph, slaughtering and meat-packing, tanning, boot and shoe, electric light and power, lumber, and automobile-tire industries.

Summarizations of the data obtained by the Bureau on wages and hours in 1931 in foundries and machine shops, silk and rayon goods manufacturing, bituminous coal mining, and the iron and steel industry have been carried in recent issues of the *Monthly Labor Review*.

The study of hiring and separation methods in representative manufacturing plants of the United States is being continued.

The reports on volume of employment in the building industry, publication of which was begun by the Bureau early in 1931, are being constantly expanded, as is also the other regular work on volume of employment. Information on volume of employment is being published at present for 85 manufacturing industries and for 14 groups of non-manufacturing industries. Index numbers of employment and pay roll are given for 54 manufacturing industries and for 12 of the non-manufacturing groups.

Among the bulletins of the Bureau recently published are the 1931 edition of the *Handbook of Labor Statistics*, a study of labor conditions of women and children in Japan, and bulletins giving translations of the labor legislation of Ecuador, Paraguay, and Venezuela.

Women's Bureau, United States Department of Labor.—In August and September, 1930, the Women's Bureau conducted a survey of unemployment in South Bend, Indiana, and the adjoining town of Mishawaka. This community is important industrially in proportion to its size, it is representative of a number of different industries, and it is not too large for a house-to-house canvass of its industrial sections.

All told, 3,245 women reported on their employment status during the preceding 12 months and at the time of the survey. Information obtained through personal interviews with the women in their homes included age, marital status, country of birth, industry, employment history for the past five years, broken and irregular employment during the past 12 months, with changes in hours and earnings, and statements in regard to economic status and existing financial difficulties. Although just over one-third of the women had escaped lay-offs, of one week or longer, the others had lost an average of 6½ weeks per woman, 18 per cent (367 women) had been idle from two to six months, and 83 women had worked less than half the year. Some 1,700 women reported reduced earnings. Material was obtained also as to size of the family, total number of wage-earners earlier in the year and at time of survey, steadiness of employment, and economic difficulties. The number of families of two or more members reported upon was 2,576, comprising 11,316 persons.

It had been customary in these families for large proportions of the members to be gainfully occupied. At an earlier time within the 12 months only 219 families had been dependent upon one wage earner each, but at the time of the interview there were 765 in which only one person was working. For all but five of the latter, the relationship of the sole wage earner was learned; in 371 cases it was the husband or father, in 228 cases it was the wife or mother, in 120 cases it was a daughter, in 20 cases it was a sister or other woman, and in 21 cases it was a son or other man. In 134 families in which the husband was not employed, the wife was the sole wage earner. In about 100 cases a woman was the only person working in a family of five or more members.

In 89 families and 19 cases of women living alone, there was no wage earner, even

part time, and in 1,214 cases, although there was some one at work, no one had a steady job.

Pay-roll figures from plant records show reduced hours and earnings. For example, certain establishments in three industries, largely clothing and footwear, reported the amounts paid to 2,746 women in September, 1929, the median being $17.80 for the week. In September, 1930, the number of women was 2,483 and the median was $13.35. At the earlier date, only 9.9 per cent of the women received less than $10; at the later date, 23.9 per cent did so. In the same period hours had been reduced, their medians being 45.1 for the week in September, 1929, and 39.2 for the week in September, 1930.

Field work and tabulation have been completed on a general survey of new methods of work and their effects on women workers in the cigar and cigarette industries.

In addition, two general handbooks on the best available standards and practices in regard to *The Installation and Maintenance of Toilet Facilities in Places of Employment*, and *The Lighting of Work Places* are in process.

The Bureau of Agricultural Economics.—A monthly mimeographed publication called "The Dairy Situation," prepared by a Dairy Statistics Committee in the Bureau of Agricultural Economics, was inaugurated with the September, 1931, issue. This report includes general comments on farm and factory production, the dairy feed situation, pasture and weather conditions, farm and market prices, market receipts, storage movements, foreign markets, etc. It is a general review of the dairy situation as a whole and is intended to be of use to persons connected with all branches of the industry.

As a result of a milk consumption survey conducted in Boston, and sponsored by the New England Research Council, the Bureau of Agricultural Economics, and other organizations, a report prepared by Mr. F. V. Waugh, Executive Secretary of the New England Research Council, was published in September, 1931, under the title "The Consumption of Milk and Dairy Products in Metropolitan Boston in December, 1930."

A mimeographed publication containing charts, by L. H. Bean of the Bureau of Agricultural Economics, is just off the press. This statement is entitled "Factors Related to Acreage, Production, and Prices of Potatoes in Florida," and is a summary of outlook talks presented to growers in LaCrosse and Hastings, Florida, in November, 1931.

The annual outlook conference was held by the Department of Agriculture in Washington, January 25–29, 1932, and the Agricultural Outlook report was released February 1, 1932.

The Canadian Census.—Provisional totals, by provinces, of the population of Canada according to the Census taken as of June 1, 1931, were announced by the Dominion Bureau of Statistics on November 30. The grand total for the Dominion was 10,353,778, an increase of 17.82 per cent over 1921. The largest absolute gain (509,128) was in the province of Quebec, but the rate of increase was greater in British Columbia and Alberta than in Quebec, viz., 31.38 per cent and 23.63 per cent respectively, compared with 21.56 per cent in Quebec. These results have been issued two months earlier than in any previous Census. The punching of the population cards for the final compilations will, it is hoped, be completed by March.

Statistics of Blindness.—A Committee on Statistics of the Blind, appointed in 1929 following a conference of workers for the blind and others interested in improvement

of statistics relating to the blind, has prepared and published a proposed standard classification of causes of blindness, a proposed combination of scales for uniform classification of the blind according to amount of visual perception, and a proposed standard form for physicians' reports on eye examinations. This Committee consists of Dr. Franklin B. Royer, Association for Prevention of Blindness, New York; Miss Evelyn C. McKay, American Foundation for the Blind, New York; Stetson K. Ryan, Connecticut Board of Education of the Blind; Bennett Mead, United States Department of Justice, formerly of the Bureau of the Census, and Ralph G. Hurlin of the Russell Sage Foundation. Criticisms of the proposed classification, scale, and form are invited and copies may be obtained from the Secretary of the Committee, Miss McKay. A review of the work of this Committee to date was published in the December, 1931, issue of the *Outlook for the Blind*.

Personal Notes

Dr. Edmond E. Lincoln has been transferred from the International Telephone and Telegraph Corporation to the duPont Company, with headquarters in Wilmington. His work will be primarily with the Executive and Finance Committees.

Dr. Woodlief Thomas accompanied Dr. Walter W. Stewart to Basle in December to assist him in his work as the American member of the Special Advisory Committee convened by the Bank for International Settlements under the provisions of the Young Plan.

Dr. Louis Block has been appointed Secretary and Director of Surveys of the California State Unemployment Commission. He has been transferred to this commission from the California Department of Industrial Relations, where he has served as Statistician since 1922.

William Jaffé, Professor of Economics at Northwestern University, is to be in Paris during the summer of 1932 where he will conduct under the auspices of the University of Paris a Seminar in Social Science Research in Paris, from June 15 to July 31, 1932, for Americans interested in research in France.

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Amberg, Joshua L., Hyman and Company, 61 Broadway, New York City

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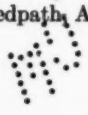

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Torrey, Dr. Marian M., Goucher College, Baltimore, Md.

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Woodward, Donald B., Financial Editor, The Business Week, McGraw-Hill Publishing Company, 337 West 42 Street, New York City

REVIEWS

International Migrations, edited by Walter F. Willcox on behalf of the National Bureau of Economic Research. New York: National Bureau of Economic Research, Inc. 1929. 2 vols., 1112, 715 pp.

This study, financed by the Social Science Research Council and carried out under the direction of Professor Walter F. Willcox for the National Bureau of Economic Research, brings together the best available material on migration during the nineteenth century and the early part (until 1924) of the twentieth. It is divided into two distinct parts. Volume I deals with the statistics of migration and was prepared, under agreement with the International Labour Office, by Dr. Imre Ferenczi. Volume II consists of a series of papers by various scholars dealing with national immigration and emigration currents, Professor Willcox's introductory paper on world population being the only one not dealing directly with some phase of migration.

Clearly no review can do more than give the most meager notion of the contents and value of these volumes. Volume I seems to the reviewer to cover, as adequately as data and space permit, the actual movements of people across national frontiers during the period under consideration. The introductory and textual material, comprising about one-quarter of the volume, serves as a commentary on the tables given later and is useful to the student in a variety of ways: it gives a general survey of the movements which the tables set forth in more detail; it calls attention to the difficulties encountered and the limitations of the data; and it sets forth rather briefly the background of modern mass migration. However, it is to Volume II that one will turn for the understanding and interpretation of the data. This was the intention of Professor Willcox in planning the work.

Volume II is introduced by a study of the increase of world population since 1650 by Professor Willcox. To the reviewer this happens to be the most interesting part of the book. Although it does not directly deal with migration, it is certainly relevant to a study of world movements. Professor Willcox has brought together here a mass of information which all students of population will frequently use. The largest element of uncertainty in recent estimates of world population, Professor Willcox finds to be the probable size of China's population. In this the reviewer is in entire agreement with him but he finds himself unable to accept such a definite figure as Professor Willcox gives because of lack of confidence in the Chinese data. The difficulties of census taking in China are well-nigh incredible and the margin of error cannot but be very great.

All the papers dealing with particular migration currents are of interest, though by no means of equal worth. There is necessarily much repetition in them because, after all, the composition of immigrant and emigrant populations is much the same in most countries, and the causes which determine immigration and emigration are much the same in Argentina and the United States or in England and Italy.

The reviewer found Dr. Hersch's paper on the Jews of particular interest. It

is the most comprehensive and thorough of these chapters. Several of the others would have been improved if the authors had had Dr. Hersch's before them as a model. Dr. Hersch has not only made his chapter a commentary on the statistical tables in Volume I but he has set forth clearly the characteristics—age, sex, occupation, and so forth—of Jewish migrants and the circumstances determining their movements.

Almost equally good is Dr. Ratti's chapter on the Italians. It will contribute not a little to the better understanding of the mass migration from Italy in recent decades.

The chapter on India deals largely with the difficulties Indian emigrants encounter abroad, shedding but little light on the conditions in India which might favor or discourage emigration. The chapter on Japan is unsatisfactory from the same standpoint and does little but discuss the validity of the statistics.

Several of the chapters on northwest European emigration, while good, add but little to the common knowledge of these movements. This is perhaps inevitable under the circumstances.

Certainly this work will prove indispensable to all those using migration statistics and will also prove enlightening to those with only a casual interest in human migration, although it does not touch upon many of the most important problems of migration which we shall have to face in the not-distant future.

WARREN S. THOMPSON

Research in Public Finance in Relation to Agriculture—Scope and Method, edited by John D. Black, and prepared under the direction of the Advisory Committee on Social and Economic Research in Agriculture. New York: Social Science Research Council, Bulletin No. 1. December, 1930. 174 pp.

This is a document which raises great expectations. It is the first bulletin of the Social Science Research Council, whose effort to contribute to the advancement of science is sponsored by seven learned societies, including the American Economic Association and the American Statistical Association. It deals with research in the field of public finance—a field of great difficulty and complexity and one in which the special interests of groups, even of academic groups, tend to distort the objectivity of research. The document addresses itself to certain problems of agriculture—problems which are the focal points of political controversy and which are claimed as the particular province of a group of students who have come to be known in recent years as agricultural economists. It is to assist this group and especially the numerous workers in the agricultural colleges who are in a position to undertake detailed researches that this present bulletin and others to follow have been prepared.

The statement of objectives (p. 3) reads as follows:

> The specific ends in view . . . were to mark off this field of agricultural economic research, outline its content, describe the research projects already undertaken in this field, point out additional projects which might be undertaken, review and evaluate the methodology employed in projects completed or under way, and suggest methods and procedures that may be used to advantage in different types of projects both old and new.

Truly this is an undertaking which is well-conceived and extremely promising of valuable results.

The report is admirably outlined. It begins with a series of introductory sections dealing with "objectives," "the field of research," "basic principles, concepts and measures," "history of research in public finance in relation to agriculture" and "sources of research data." The bulk of the book (150 of the 174 pages) is then devoted to a discussion of forty-five individual research projects grouped under ten headings. Credit for the general scheme of organization is assigned to a Special Advisory Committee constituted as follows: John D. Black (chairman), Eric Englund (executive secretary), M. S. Kendrick and R. W. Newton. This committee "met and drew up the general outline for the report, made suggestions as to persons to help with various parts of it, and finally approved it for publication."

A list of twenty-three contributors to the report is printed (p. 2), a list which contains the names of only two economists (Fred R. Fairchild and J. W. Martin) who are not prominently identified with the agricultural-economics group. Martin's contribution is an excellent statement regarding motor vehicle taxation (pp. 128–136). Fairchild is credited with having "read and criticised parts of this manuscript," with no indication as to the character of his criticism or the extent to which it was heeded. All the members of the Advisory Committee are listed as contributors, Kendrick collaborating in the discussion of one project, Newton being solely responsible for one project and collaborating on a second, and Englund being assigned no specific credit or responsibility. It is apparent that it was upon the shoulders of Chairman Black that the weight of the burden fell. His name appears in connection with no less than seventeen of the sections and projects. Professor Black has won for himself an enviable reputation as an agricultural economist, but, so far as the reviewer is aware, has previously evidenced no particular interest in problems of public finance. Next to Black the most active contributor was George Peterson, formerly with the federal Treasury and now with the Giannini Foundation (11 citations). The name of H. I. Richards, of the Harvard Committee on Economic Research, appears three times, and that of B. W. Allin of the federal Department of Agriculture appears twice. The other fifteen contributors were concerned with the discussion of single projects only. Clearly the report is essentially a product of the group of agricultural economists, and is to be accepted as their conception of the research problems of public finance as they affect the field of their special interest.

As is perhaps inevitable when the contributions come from so many individuals, the discussions of the projects vary widely in quality. Six of the forty-five projects are merely listed by title. Nine more are dismissed with a few words of comment. Two of the best, Martin's discussion of special motor vehicle taxation and Mort's discussion of a state plan for financing a minimum program of education, are already available in substance in easily accessible documents. Particularly interesting are C. C. Zimmerman's contribution regarding attitudes of the public and the Hibbard and Black analysis of the plan for taxing farm real estate on its annual net product. The first eight projects (Groups A and B), which are simple and predominantly descriptive in character, are fully and sys-

tematically developed. Undoubtedly they will prove helpful to agricultural economists undertaking tasks in this field. However, it is surprising how few of the projects demand the peculiar qualifications of an agricultural, as contrasted with a common or garden variety of economist.

Before one has read a dozen pages in this report he begins to be irritated and disturbed by the evidences of gross carelessness in its preparation. In a document which is designed to serve as a standard and guide for research workers, it seems especially desirable that reasonable standards of English form and of proof reading be observed. The frequent errors of grammar and punctuation suggest that the report may have been "dictated but not read." The following specific cases will serve to support the justice of this criticism.

On page 11, a dropped word makes John Stuart Mill responsible for the statement that "Governments generally do things less than private individuals!"

On page 14, the heading "3" and on page 18, the heading "4" should apparently be "C" and "D."

On page 21, appears this sentence: "This will point the way to the keeping of better records and the working out of more useful classifications and tabulations in the official annual reports, which is one of the most important functions which research in this field can perform."

Another dropped word on page 23 results in the statement that ". . . some of these studies have not been carefully enough made to discover the real meaning of some of the terms used and the pitfalls involved using the data."

Considerable ingenuity is needed to unscramble the following two sentences which appear on page 28: "Several states, like Massachusetts, publish reports which contain a consolidation of all local accounts in the other states. Recourse to more primary sources of information is a practical necessity if the entire field be covered."

On page 140, the citation (3) refers to a footnote on page 139. This sentence also appears: "The qualitative procedure will need to be a comparison of relatives prices of the products."

On page 160, Professor Adams is referred to as having made a presidential address before the "American Economics Association."

It is easy to over-emphasize the importance of such slips as these, but their presence in large numbers is certain to weaken the influence and to detract from the usefulness of the report.

Unfortunately, however, the shortcomings of the document are not confined to such minor blemishes. Thus the section headed "Basic principles, concepts and measures" starts bravely forth "to name, and in some instances also briefly to state or define, the principles or theories, concepts and measures that are involved in research in public finance in relation to agriculture" (p. 8). These are fair words but, when one reads critically the section headed "Public Finance" (pp. 14–18), irritation arising from lapses in form gives way to bewilderment and amazement. As an example of the quality of the presentation, consider the following excerpt (pp. 14–15):

> Agricultural economics [sic] working in the field of public finance are inclined to reason as if no taxes paid by farmers are shifted. They overlook the fact

> that there is probably a relationship between the division of ordinary taxes for road support between city and country and the prices at which farm products in the long run sell in urban markets. They also forget at times the probable shifting to agriculture of some of the taxes on railroad and industrial property.

Does the writer submit the last statement in support of the first, even though it concerns not a tax paid by the farmer and then shifted to others but rather a tax paid by a utility and then shifted to the farmer?

The following paragraph appears in the same section (p. 16): "Present discussion of bases of taxation is inclined to emphasize certainty and regularity of income considerably. This is, of course, an administrative criterion largely. Other writers stress diversity as desirable. A principal reason for diversity is that it means reaching more of the wealth and income of those able to pay." Diversity, largely, appears in this paragraph to have eliminated certainty and regularity, considerably!

The next paragraph plumbs the depths (p. 16):

> The question of the best bases for pro rating taxes should not be analyzed as an issue in social justice; but rather as one of who [sic] is in a position to support public activities with the least loss in his real net income. Obviously, those who have accumulated the most, or earned the most, either because of the help of government or not, are in the position named.

Indeed, this entire section reads like a literal transcript from the notebook of a sleepy student in a freshman lecture course. Terms are carelessly and loosely used (e.g., "base" on pages 15–17 and "property" and "land" in the second paragraph on page 15). Doubtful statements are set forth with unbecoming dogmatism. It is difficult to imagine what excuse there can be for the inclusion of material of this quality when there are good elementary texts in public finance freely available.

Judged by standards of what might be reasonably expected in a document of this character, the volume under review must indeed be pronounced a disappointment. A promising opportunity has been lost. If the book truly reflects the quality of the leadership in research among the agricultural economists, they must expect to be received as workers in the field of public finance with distrust and even apprehension. Students in this field are eager for new light from whatever direction it may be offered; to the agricultural economist, as interpreted in this volume, they raise the tragic Biblical lamentation: "But if the light in thee be darkness, how great is that darkness!"

ROBERT MURRAY HAIG

Columbia University

The Rôle of Agricultural Fluctuations in the Business Cycle, by Vladimir P. Timoshenko. Ann Arbor: The University of Michigan. 1930. 89 pp.

The purpose of this study is "to demonstrate how large a rôle agricultural fluctuations have played in initiating business cycles in this country." Had the author been a bit less ardent in the defense of his thesis and a bit more generous with unfavorable evidence, his arguments would have carried more conviction.

As it is, many of the conclusions, when subjected to close scrutiny, do not appear to be established beyond reasonable doubt.

In skeleton, Mr. Timoshenko's argument is as follows: There exist cycles of agricultural production in the United States, which, with some modifications from world crops, generate cycles of agricultural prices. Agricultural and industrial prices have somewhat similar cyclical movements, but due to the larger amplitude of the former and some dissimilarities of timing, the ratio of agricultural to industrial prices exhibits cyclical fluctuations. A low ratio generally coincides with or precedes recovery; a high ratio generally coincides with or precedes recession. Large crops and low prices of farm products are favorable to recovery because (a) they increase the profits of manufacturers using agricultural raw materials, (b) they increase the purchasing power of railroads, commission men and others handling farm produce, and (c) they reduce the food cost of living and increase the amounts consumers have available for expenditure on industrial products. Furthermore, big crops and low prices make for enlarged quantities and values of farm product exports and lead to a "favorable" balance of trade and gold imports. These gold imports bring about an expansion of money in circulation and of credit. Finally, a year-by-year comparison of business annals with the volume of farm production, the value of agricultural exports and the agricultural-industrial price ratio shows the dependence of the business cycle on these factors.

This train of arguments is vulnerable at several points. In the first place, the very existence of cycles in farm production is not adequately established. Just what is meant by cycles and what are the criteria for detecting them are crucial matters upon which we are not enlightened. Would the author maintain, for example, that there were cycles in an original series of random deviations if a two-year moving average of such deviations exhibited fairly marked cyclical movements (serial correlation = 0.5)? If not, he would have great difficulty in establishing the existence of cycles of crop production.

In support of the generalization that fluctuations in farm prices may be fully explained by variations in the volume of crops in the United States and abroad there is given a correlation of -0.734 between indexes of domestic prices and volume of crops, a chart of these series, and an explanation that the lack of relation in certain years was due to unusual foreign crop conditions. On the basis of this partial evidence the author concludes that "there is no necessity for any additional explanation of the cycles in agricultural prices revealed by the index of farm prices of ten leading crops." Apparently it is thought that cyclical fluctuations in consumers' incomes and in the prices of industrial commodities have a negligible influence on farm prices!

The reasoning with regard to the effects of large crops and a low agricultural-industrial price ratio in stimulating a recovery from depression is in part sound. Without doubt, relatively low raw-material costs and enlarged volume of operations in industries, merchandising, transporting, and processing farm products are, in themselves, favorable factors. Increased activity in these lines can cause expansion in other lines of business, especially if it involves additions to plant and equipment, i.e., the production of permanent capital goods. But there are

restrictive effects of large crops and low prices which the author fails to discuss. If the farmer gets a smaller total return for his crop and the final consumers pay a larger total price for farm products, *ceteris paribus*, they have less of their incomes to spend on other industrial products. Of course, other things are not equal—and the ultimate question is whether the cumulative expansive effects finally outbalance the cumulative restrictive effects on industrial production—a question in economic dynamics to which it is not easy to give any decisive general answer. In this connection, attention should be called to the conflict of the claim that "a low level of agricultural prices permits all consumers to spend a smaller part of their incomes for food" (p. 20) with the assertion that "the elasticity of demand when measured in connection with retail prices is larger than unity for practically all agricultural products" (p. 60).

The tracing of effects from large crops and low prices to large exports, a favorable balance of trade, gold imports, increased money in circulation, increased bank reserves and an expansion of credit is clear enough. But most of the correlations between successive pairs of variables in the line of argument are only moderately high. And the effects of the original factor, fluctuations in crop volume, in the final phenomena are not easily appraised.

The resort to a comparison of agricultural factors with business annals when correlation methods yield somewhat inconclusive results is not a procedure to be commended. For such a comparison is so highly subjective and flexible as to involve large but unknown errors. If the author insists on varying lags there is available multiple correlation analysis in which the agricultural factor with various lags can serve as two or more independent variables.

Here and there are to be found statements lacking in precision. On page 7 there is a rather serious exaggeration of the amplitude of the cycles in a two-year moving average of crop production: "deviations of ten per cent from the trend are not rare and in a majority of cases the deviations are larger than five per cent." Actually there is only one deviation out of fifty-five as large as ten per cent and only twelve greater than five per cent. On page 64 occurs a curious non-sequitur. To support the contention that "lags are more regular when development is followed from revival to depression than when it begins with depression," there is cited the fact that stock prices are more closely correlated (using the best lags) with interest rates following than with interest rates preceding. The author's argument would have been equally valid in support of exactly the opposite conclusion!

If there is much to criticize in this study it is at least in part attributable to the difficulty of the problem. For the monograph bears the marks of hard work, technical ability, and a constructive imagination. Scrupulous care in checking theories and facts coupled with a determination to present both sides of the case would have made it an excellent piece of research.

THEODORE O. YNTEMA

The University of Chicago

Federal Financing: A Study of the Methods Employed by the Treasury in Its Borrowing Operations, by Robert A. Love. New York: Columbia University Press. 1931. 256 pp.

It is no small reproach to American economists that an adequate study of our national finances remains to be written. The spade-work of H. C. Adams, Bullock, Dewey, Mitchell, Catterall, a generation ago, held out promise which has not been fulfilled. What remained undone before 1914 must inevitably have waited until our war financing should have "settled"; but a sufficient interval has since elapsed.

Dr. Love's book will not fill the gap; it was probably not designed to do so. The foreword of Professor Seligman is a just account: "The author has discussed with great intelligence some of the less familiar aspects of our fiscal policy." The earlier ground has been retraversed; the dry bones of Liberty Loan financing have been exhumed; examination has been made of administrative and legislative records. But in gathering the leaves, the forest has escaped. To the fiscal student of another generation, the dominant fact of our late financing is that the Treasury prepared for the War, carried it on, and extricated itself from immediate commitments by means of inflation. Of this fact no reader of Dr. Love's book would be made aware.

The lamented Francis A. Walker years ago likened the effect of Thornton's unassuming *Fortnightly* article in evoking Mill's recantation of the wage fund theory, to the bewilderment of a hunter who pops away at an overhead squirrel and has a bear come toppling stone dead at his feet. In something of this spirit at least one reader after trudging through page after page of Dr. Love's chronicle, wincing at restraint become avoidance ("too controversial to summarize here"; p. 218) has rubbed his eyes in delight at the vigor of a final paragraph:

> In not a single major period in American finance has the Treasury manipulated matters so as to avoid the unfortunate confusion and the costly results which follow in the wake of badly used financing tactics. The misuse of both security features and financing devices may accordingly be described as characteristic of American financing. This unfortunate situation cannot be explained in any terms other than those describing ignorance of the principles of finance, lack of knowledge of financing tactics, and unfamiliarity with the operation of adopted measures. The only consolation we get out of this thought is that there is some chance that the future will witness the elimination of the defects of the past.

Admirable in appraisal and commendable in piety.

JACOB H. HOLLANDER

Johns Hopkins University

Government Control of Crude Rubber, by Charles R. Whittlesey. Princeton: Princeton University Press. 1931. 229 pp.

This book, the second of the publications of the International Finance Section of the Department of Economics and Social Institution in Princeton University, on the Walker Foundation, is an exhaustive examination of the British Government's recent attempt to stabilize the price of crude rubber (Stevenson Plan, 1922–1928). The study attempts "to analyze the conditions that led to government control in the industry, to examine the plan itself with all its various modi-

fications, and to assess the effects of restriction upon producing countries, upon the principal consuming country (America) and upon the principal investing country (England)."

With the exception of the theoretical content of the concluding chapters, the study is a factual description of all sides of the restriction question. The author has done a careful and thorough piece of work but the complete absence of any statistical analysis of the plenteous data and the little use made of graphic methods in their presentation are disappointing. No attempt has been made to relate changes in the supply and demand factors, or to contrast the scattered elements of the problem. In the thirty-five tables, however, much statistical detail is presented, for the investigation has scarcely left a phase of the subject untouched. A comprehensive bibliography is also included. As an authoritative reference work, the book is invaluable.

To understand fully the problems confronting the rubber producers it is necessary to appreciate the continuing nature of their industry, with some five or six years, on the average, required for the maturing of the rubber trees. The expansion of rubber production in the Dutch East Indies during restriction (1922–1928) was only made possible by the extensive plantings during and immediately following the World War, while the even greater plantings encouraged by restriction prices have just come into production within the past few years. It is of striking significance that in this greatly increased Dutch production the rôle played by the small-scale, native producers, as contrasted with that of the large plantations, has been increasingly important. Because of lower all-in production costs, these independent native growers may eventually displace their European competitors, and any future attempts at price control will be greatly handicapped as a result.

In view of this long term nature of the industry, reduction of the fluctuations in the price of crude rubber is essential to rationalized production. Stabilization of prices, moreover, is not of itself contrary to the interests of the rubber manufacturers in the United States. Chief among their objections to the Stevenson Plan were the undue amount of uncertainty allowed to arise concerning restriction policies, and the extreme inflexibility of the control mechanism—both questions, not of principle, but of administrative control. Aside, however, from allaying the rising fear among American consumers of a future shortage of crude rubber, the disadvantages of the experiment, to both the producer and the consumer, have far outweighed any possible gains.

The history of the Stevenson Plan has again shown that any stabilization scheme which concerns itself solely with current production and neglects the fundamentally more important question of productive capacity is bound to fail. Temporary gains found in the liquidation of accumulated stocks are more than offset by greatly increased potential supplies. And in view of the present need for a critical evaluation of all attempts at the control of economic processes, investigations such as the one under review are especially welcome.

CHARLES A. BLISS

American Industry and Commerce, by Edward Dana Durand. Boston: Ginn and Company. 1930. xviii, 653 pp.

The attempt to describe and interpret the United States has been for some years the sport of foreign visitors. Their descriptions have usually been impressionistic with obvious attempts to be brilliant in style and startling in concept. It will no longer be necessary for them even to visit the United States to gather material. Dr. Durand has undertaken "to set forth systematically the major facts regarding the present riches of the country, the character and magnitude of its industries and commerce, and the history of its material developments, especially during recent decades." Such an undertaking is a most difficult assignment, even for one with Dr. Durand's ability and background. As a former director of the United States Bureau of the Census and at present statistical assistant to the Secretary of Commerce, his familiarity with available statistics is unquestioned. Both the *Statistical Abstract of the United States* and the invaluable *Commerce Yearbook* series have passed through his hands. The volume represents the most complete summary of American economic life in statistical terms which the reviewer has ever seen, short of a five-foot shelf of the original sources themselves. It is a powerful demonstration of the utility of statistical measures in tracing historical trends and in describing present conditions.

The plan of the book is one of giving a picture of American well-being and then explaining how it has come about. The first chapter presents data on the national income, wages, the volume of production and consumption, leisure and recreation and the like. The demonstration is very clearly one of world leadership. Dr. Durand feels that it is now possible to say that "for the first time in history man has reached a height whence he can dimly see ahead the Promised Land. From the material standpoint, at least, the Utopia of the philosophers and the romancers seems no longer an altogether idle dream." (p. xvi.) The book then proceeds to describe the developments of the 19th and 20th centuries, with separate chapters discussing the primary factors in American progress, population and natural resources, and a further chapter discussing secondary factors, including the spread of education and research, the position and attitude of labor, the use of capital, heat and power, large scale enterprise, mass production, system, and the combination of initiative and collective action. The remainder of the book deals with various divisions of economic activity, industrial and geographical, ending with a discussion of foreign trade. The subject-matter relates primarily to the production and distribution of commodities. The banking system and the security markets, the character of taxation, the extent of trade unionism and many other similar topics do not fall within the scope of the book. Yet one hesitates even to mention omissions, in the face of the extraordinary area which Dr. Durand does succeed in covering with clarity and succinctness.

Dr. Durand's interest is in the long term trend and many of his statistics are in terms of decades or longer intervals. Such matters as the present depression do not concern his study. As he puts it, "from the broad point of view the crises of the past have been mere waves on the stream blowing steadily onward." (p. 208.) The problem of technological unemployment is dismissed by remark-

ing on the new fields in which employment has increased. The farmers are shown to be better off than at the beginning of the century and the present agricultural difficulties are discussed briefly in connection with price movements. The petroleum industry is presented as an example of enterprise, ingenuity and daring. The entire field of marketing is given little consideration because of the absence of reliable information. Advertising is included as part of the "reasoned conduct of business" and the supremacy of the United States in this field is found to be a factor in prosperity and progress. The tariff has no mention in the chapter on foreign trade. Realizing the danger of being classed as an over-zealous apologist for the American economic order, Dr. Durand cautiously disclaims in the introduction any advocacy of every American institution and practise. His position is rather that the "real prosperity and progress of the country and the real well-being of the masses of the people (as judged, of course, by comparison with other peoples and other periods of time) do constitute strong arguments in support of the general soundness of American economic and political institutions and policies." (p. xvii.)

The volume is not merely a statistical summary. Dr. Durand has cleverly reduced the volume of statistics by using graphs wherever possible. Beyond this, however, should be noted his continual running comment on the adequacy of the statistical material and in interpretation of the data. His comments on national income estimates, cost of living estimates and production indexes are shrewd. In the field of interpretation, it should be noted that Dr. Durand is a firm believer in historical continuity. He dismisses the problem of over-capacity by saying that "capital has been piling up and productive capacity expanding, not only in America but pretty much all over the world, through all modern history. Yet prosperity and well-being are much higher than ever before in America." (p. 207.) He dismisses the question of the development of manufactures in economically backward countries reducing the demand for the products of the leading industrial countries, by remarking that a similar development has gone on for decades without reducing the exports of industrial countries. The same logic leads to the anticipation of further prosperity and progress for America. Dr. Durand wisely emphasizes the fact that "the wealth which by good fortune is theirs (Americans') does bring with it the possibility and the duty of exercising a large measure of leadership in the economic life of the world and, if they prove worthy, a large share of leadership in all that constitutes civilization." (p. xvi.)

WILLARD L. THORP

Amherst College

America Weighs Her Gold, by James Harvey Rogers. New Haven: Yale University Press. 1931. 245 pp.

Professor Rogers has performed a useful service by reminding us that gold movements are caused not only by those forces which shifts in the gold supply produce, but also by the many diverse elements that comprise the balance of international payments. He has marshalled the available facts to show how and

why the automatic adjustments assumed in international trade theory have failed to operate in the last fifteen years. Now when there is so much discussion of the maldistribution of gold, such an analysis is needed to show the various channels through which any redistribution of the gold supply will have to be effected.

Illustration of the complexity of the problem is provided by the sequence of events that led to the increase in the post-war monetary gold stock of the United States. Credits were first given to belligerent countries to cover sales of war supplies and consumption goods at high prices. Post-war attempts to repay these unproductive credits by nations impoverished by the lack of productive equipment and at lower price levels inevitably led to the shipment of gold. This gold at first failed to exercise an influence upon credit and prices in this country because it was used to reduce the indebtedness of member banks at the reserve banks. This represented the liquidation of the war-time inflation. Foreigners liquidated their debts to us by shipping gold, which relieved us of some of the burden of liquidation, but did so only because currency depreciation had made gold unnecessary.

Analyses of balances of payments since 1922 reveal the large international movements of capital and short-term credits, which balanced this country's excess of exports and receipts from foreign debts and made unnecessary the trade and price adjustments which should theoretically have resulted from gold imports. The expansion of credit in this country on the basis of the new gold led to active bond and stock markets, including for a period a voracious appetite for foreign securities. The growing speculative mania for American stocks not only led to the excessive use of credit for domestic purposes and checked the sale of foreign securities in this market, but in addition attracted funds from abroad for investment in American stocks and for lending on our tightening money markets.

The strain these developments placed upon money and commodity markets, the eventual breakdown, and the subsequent depression are described. Again, as after the War, international exchange of goods and capital broke down under the process of credit liquidation, and it was necessary for foreigners to ship us gold to meet maturing obligations. Again, in the absence of domestic demands for new credit, this gold was partially used to reduce obligations of member banks at the reserve banks.

Professor Rogers uses the balance-of-payments estimates of the Department of Commerce to illustrate the developments of the 1922–1930 period. The limitation of the figures presented, however, to net balances of capital and credit movements, as well as of commodity trade, fails to reveal the relative magnitude of the various offsetting forces, e.g., the heavy investments of foreigners in American securities during 1928 when American investments abroad also reached their maximum. Statistically, the total magnitudes are probably less accurate than the net movements, but for the purpose of appraising the various forces at work the totals are often important.

Considerable emphasis is placed upon the American tariff as a preventive of normal trade adjustments. The vehemence of the author on this point and the emotional quality of some of his argument seem to this reviewer, despite sym-

pathy with the viewpoint expressed, to detract somewhat from the strength of the position taken. A more objective attitude might have been more convincing. The attitude of our government toward war debts is also condemned with some vehemence. In any event it is clear that these official policies were important factors in complicating the task of balancing international payments and in making persistent the tendency for gold to flow to this country.

In approaching suggested solutions, Professor Rogers presents a chapter of literary quotations, ranging from Fabre's description of caterpillars blindly following each other in a circle to André Siegfried's description of the Scopes trial and a political campaign argument for the tariff, designed to show the tendency of animal and man to persist in following established grooves of thought and action although the way to betterment lies within view of those who would see. One gathers from the remaining chapters that in Professor Rogers' opinion the way to betterment lies in three channels: easing of tariffs and trade restrictions, reduction or cancellation of war debts, and raising of prices through the medium of central bank credit policy.

Professor Rogers does not develop the processes by which central bank credit policy may bring about the necessary readjustment. His belief that something can be done is stated as dogma, primarily on the basis of the principle of economic theory that easier money in one country than in others eventually brings about the price readjustments which will effect the balancing of international payments through trade channels. Earlier chapters of the book demonstrate clearly that such price readjustments did not take place in the 1922–1929 period. Can it be assumed that they will in the future? If so, then it needs to be explained what different factors may be operative. In the past decade the adjustment was made through the export of American capital and credits, which provided foreigners with purchasing power to buy our goods. But did they first get our credits and then buy from us or did they purchase our exports and then find it necessary to obtain funds to balance their payments? Quite obviously it is futile to attempt to fix such sequences; both undoubtedly occurred.

It yet remains to be explained why our exports were not curtailed when loss of gold and borrowing by other countries were necessary to pay for them. The types of goods sold, cost differentials, selling methods, etc., must to some extent determine the flow of commodity trade independent of credit factors. There were also influences which kept prices from rising in this country despite the abundance of credit. Will these influences continue to operate? These independent trade and industrial factors assisted in determining the international flow of goods and funds. It would be instructive to know, for example, why exports from this country maintained their relative position in the total of world trade and those of Germany increased, while the position of England in this respect deteriorated. These contrasts must be to a large extent due to those various factors that determine competitive supremacy in trade rather than to the balancing of opposite credit and capital movements. It could hardly be expected that Professor Rogers would attack this complex question in a book of limited scope, but an analysis of trade as well as of credit factors is needed for a full understanding of the so-called gold problem.

Dramatic events of recent weeks, since this book went to the printer, have effected a redistribution of the world's gold supply in a manner and for reasons not suggested by Professor Rogers. The initial phases of the present crisis are discussed but the probability of a tremendous flow of gold from this country because of a breakdown of confidence, a flight from the gold-exchange standard, and a world-wide passion for liquidity was apparently not anticipated. Professor Rogers mentions the influence of the gold-exchange standard and of confidence as a determinant of the flow of gold to this country. Recent events would seem to demonstrate that funds of such a nature are subject to call in an emergency and to indicate that it is incumbent upon centers holding such balances to maintain abundant gold reserves. To the elements of trade, capital movements, and short-term money-rate differentials should be added the element of confidence as a determinant of the flow of international payments.

WOODLIEF THOMAS

An Introduction to Medical Statistics, by Hilda M. Woods and William T. Russell. London: P. S. King and Son. 1931. 125 pp.

In the preface Dr. Major Greenwood declares that the young medical men and women coming under instruction in the Division of Epidemiology and Vital Statistics of the London School of Hygiene and Tropical Medicine are taught to carry out with facility and confidence the statistical operations which a Medical Officer of Health must supervise. The object of this book, according to Dr. Greenwood, is to help these students acquire such facility and confidence.

In the opinion of the reviewer, the authors have failed definitely to accomplish the purpose they had in view. In general, it may be noted that the explanations are vague and often misleading. A few illustrations of inadequacy of treatment may be found as follows: On pages 4 and 5 "de facto" and "de jure" populations are discussed without clear definition; on page 11 the passage on quantitative data is meaningless; on page 22 the statement that the scale of a simple line chart *must* begin at 0, "even if the smallest observation is well above 0," is fallacious; on page 31 "fertility" is discussed when "fecundity" is meant; on page 35 the definition of infant mortality is clearly wrong; on page 40 the definition of an attack rate and the example of an attack rate do not agree; the text of the chapters on averages, measures of dispersion and correlation will certainly mislead students; the chapter on life tables is badly confused; and the sampling chapter seems nowhere to be suited to the needs of students examining quantitative data on pathological phenomena.

The entire book is supposed to be an introduction to medical statistics, and no definition of "medical statistics" is stated. The authors could have given at least a definition of the scope of the book, using perhaps the "assembly" definition of Oesterlen or the "investigation" definition of Prinzing, in the lack of any definition of their own, and presenting a discussion of the subject on the basis of that definition. It seems impossible to impart instruction in a subject without telling the students what the discussion is about.

E. W. KOPF

Metropolitan Life Insurance Company

An Elementary Treatise on Actuarial Mathematics, by H. Freeman, M.A., F.I.A. Cambridge University Press. 1931. 399 pp.

It is unfortunate, in view of the merits of this book, of which it is difficult to speak too highly, that the opening paragraph of this review should be in the nature of a mild criticism. It seems necessary, however, to point out that the subjects treated in the book are not what one might infer from the title, namely, the mathematics of the application of the theories of probability and of compound interest to insurance. The design of the book is to gather together into a single volume the elementary parts of those branches of general mathematics of which only the general principles are necessary for the actuarial student and thus to relieve him from the necessity of searching out in a larger treatise those parts that he needs. With this in mind we are not surprised that algebra is not one of the subjects treated. The knowledge of that subject required is so extensive that separate textbooks should be used.

The first chapter is devoted to trigonometry, covering the definition of the trigonometrical functions, the measurement of angles and the functions of the sum or difference of two angles.

The next seven chapters cover more extensively the subject of finite differences including interpolation and summation. These 112 pages with their numerous examples, if thoroughly mastered, should give a good working knowledge of the subject. Osculatory interpolation is not mentioned here but is briefly discussed later under differential calculus.

The ninth chapter takes up the question of functions and limits. The treatment is necessarily brief, and it was apparently intended as a review preparatory to the study of the differential calculus to which the next four chapters are devoted. These cover, in addition to the elementary explanations and standard forms, such subjects as expansions, maxima and minima, indeterminate forms and partial differentiation.

Four chapters are then given to the integral calculus, including integration by parts and definite integrals and a very valuable chapter on approximate integration. The last two chapters of the book cover briefly the subject of probability, one chapter taking up questions not involving the calculus and the other those involving it.

While there are a few paragraphs in the book that one might have liked better if written differently and a few typographical errors, they are not such as to detract seriously from the very great value of the work. It should be useful not only to actuarial students but also to statisticians, engineers and others requiring a practical working knowledge of the subjects covered.

ROBERT HENDERSON

Business Forecasting, by Lewis H. Haney. Boston: Ginn and Company. 1931. xiv, 378 pp.

This volume presents a condensed and non-technical summary of a wide field of established knowledge and relevant experience offered "to help lay a basis for scientific business forecasting" (p. vi). Instead of devoting itself to an excogita-

tion of objective grounds for some single system of telling the turns, as so many books on the subject do, the discussion ranges over a wide area, and is made interesting by bits of wisdom gleaned from the author's practical experience as the director of the Bureau of Business Research of New York University.

The first half of the book is a brief survey of the disciplines which provide the technique and intellectual background of forecasting. Statistical technique is discussed in Chapter II, while the statistical data available for various economic processes are listed and critically evaluated in Chapters III, IV and V. The intellectual background provided by economic theory is introduced briefly in the first chapter, and is discussed at greater detail in Chapters VI and VII which deal with the various explanations of the business cycle and *a* theory of the business cycle as conceived by the author.

The second half deals with problems of forecasting proper. The discussion stresses the procedure associated with the author's name, viz. the use of the P/V line which relates the rate of change in the volume of production to that in prices (Chap. VIII). There follow two interesting chapters on forecasting general business trends (IX and X) and a valuable discussion of forecasting for particular industries (Chap. XI). The last three Chapters (XIII–XV) are devoted to an elementary exposition of stock market forecasting, following upon rather scanty notes on commodity prices, interest rates, building activity, automobile production and retail trade (Chap. XII).

The discussion is a mixture of elementary statistics, elementary economics, considerable common sense and empirical wisdom, and not a little of pure forecasting mythology. The various parts of the book are more or less valuable as one or the other of these constituent elements preponderate in the author's treatment of the subject.

The chapters on statistical technique and the use of statistical analysis are disappointing. It is not that they are too elementary—for such was probably the expressed purpose of the author. It is that the treatment perpetuates the besetting sin of the current analysis of time series—the use of frequency-distribution measures without the realization of their limited value in application to time sequences. The usual trinity of least squares, correlation and straight line trends is discussed without any definite indication of their limitations. None of the logically more suitable methods is even mentioned. There is altogether a surprising failure to refer to the existing literature and to help the willing reader extend his knowledge of the technique of statistical experiments.

The use of data for inferential purpose is not always above reproach. The author tends to draw inferences from charts, which, on their face, might lead other observers to arrive at different conclusions, and which, because of the short period of time covered, cannot yield significant results. Thus, to cite an example, on Figure 38 (p. 253) the *S*-like line fitted to the scatter of cotton supply and prices is an obvious misfit in the second half of the diagram. Few of the charts go back of 1919, and some stop short of 1920 and 1921. The essential basis of forecasting, the establishment of repeatable statistical sequences buttressed by significant economic relationships, is frequently absent in some of the series regarded as good "forecasters."

The discussion of the concept and theories of business cycles is brief and sketchy, as are some of the author's critical comments. It is true that this is counterbalanced by a more penetrating discussion in Chapter VII which presents Dr. Haney's own viewpoint on the cycle, a theory which embraces most of the significant factors mentioned by various hypotheses. But even here there are some unwarranted generalizations, such as the precedence of the turn in prices to that in volume of production at the peak of the typical cycle.

The discussion improves in interest and increases in value as it passes to forecasting proper. Here accumulated experience lends weight to the statements made. While some emphasis is placed upon the P/V line approach, the author's catholicity permits discussion of a number of other elements and urges upon the reader a wholesome distrust of any one system of prognostication. Chapter VIII presents an unnecessarily difficult exposition of the simple ideas underlying the relation of changes in production to changes in prices. But the chapters following are stimulating. The table of "Don't for Forecasters" (p. 230) is worthy of framing. And the chapters on stock market forecasting are clear and interesting.

The contrast between the first and the second half of the book emphasizes the virtues and faults of present day forecasting. Judged by Dr. Haney's discussion, business forecasting lacks a general theory of the nature of relationships underlying prognosis, as well as the technique of properly revealing these relationships. The absorption in practical questions, the necessity of paying attention to the transient and passing elements of the day-to-day situation prevent the practitioners from attempting to formulate clearly the general logical grounds of their procedure or to exploit to the full statistical and other tools whose value should be apparent. But when it comes to practical questions, forecasters are likely to produce valuable tentative generalizations. And if they happen to be, as is Dr. Haney, temperamentally circumspect and attentive to all the elements in the situation, the description of forecasting theory in specific markets is likely to be instructive.

But without the distinct theoretical background even the best may become prey to mythology. Let the reader consider carefully the following sequence of statements: "It is common to find minor peaks, or 'shoulders,' in the curve of industrial activity, both in the expansion and in the contraction phases of the cycle. . . . The author would advance the hypotheses that *these shoulders are apt to occur at about the time that production first swings past the line of normal trend*, whether on the upward trend or during recession. The preliminary reaction on the rise may be a sort of premonitory response to growing overproduction. The rally which so frequently interrupts a major recession may be a rebound after falling below normal, the first rush of curtailment having been perhaps too rapid.

"This thought suggests the further hypothesis that *these shoulders are significant in locating the line of normal trend* and in indicating any changes therein" (pp. 162–163).

SIMON KUZNETS

National Bureau of Economic Research

Seasonal Variations in Employment in Manufacturing Industries: A Statistical Study Based on Census Data, by J. Parker Bursk. Philadelphia: University of Pennsylvania Press. 1931. 197 pp.

Konjunktur- und Saisonempfindlichkeit in der Fertigwarenwirtschaft, bearbeitet vom Institut fuer Wirtschaftsbeobachtung. Nuernberg: Verlag der Hochschulbuchhandlung Krische & Co. 1931. 48 pp.

Mr. Bursk's study, carried out under the auspices of the Industrial Research Department of the Wharton School of Finance and Commerce, is based on the employment data contained in the reports of the United States Census of Manufactures. It covers the census years during the period 1904–1925. The year 1927 was not included because the needed data, though reported, were never tabulated. "The seasonal indices were obtained by taking a selected arithmetic mean of the relatives for each month, omitting the largest and the smallest values in an endeavor to eliminate the extreme cyclical and random effects which were evident in certain years. . . . The values so obtained were centered on the average for the year taken as a hundred." These seasonal indices are presented in tabular as well as graphic form, each diagram containing a graph showing the "dispersion" of the index.

In order not to obscure the range of the actual fluctuations, the author has refrained from giving composite indices covering all of the industries analyzed. Instead, indices are presented for the separate industries or groups of industries, and, to clarify the summary picture, the seasonal ranges of the individual manufacturing industries are summed and classified into "consumer's goods" and "producer's goods." The "consumer's goods" are again divided into those subject to "elastic" and to "inelastic" demand, while the "producer's goods" are broken up into "raw materials" and "intermediate goods." A "percentage seasonal range" is given as the measure of the seasonality of every such group and the industries constituting the group.

The table below summarizes the findings as to seasonal variations and shows also the absolute effect on the wage earners involved, when the seasonal range is applied to the number of wage earners reported in the 1927 census.

	Average number employed in 1927	*Average per cent seasonal range*	*Absolute range, number wage earners*
Producer's goods	2,890,576	9.8	283,104
Raw materials	680,823	6.5	44,205
Intermediate goods	2,209,753	10.8	238,899
Consumer's goods	2,800,090	18.4	514,686
Elastic demand	2,152,337	21.8	469,359
Inelastic demand	647,753	7.0	45,327
Total, all manufacturing industries	5,690,666	14.0	797,790

An attempt to discover a relationship between the magnitude of the seasonal ranges and the percentages of female workers employed in an industry, or the seasonal ranges and the size of the establishments concerned, resulted in no significant correlation ratio.

The findings of the Wharton School study indicate that, so far as manufacturing industries are concerned, the range of the seasonal fluctuations increases as the product becomes a consumer's good (except in the case of inelastic con-

sumer's goods). The German study comes to the same conclusion. The Institut, confining itself to German manufacturing industries, sought to determine the comparative sensitivity of various branches of the manufacturing industries to cyclical and seasonal factors. It discovered that the *cyclical* influence becomes *weaker* as the consumer is approached, while the *seasonal* influence *grows* in the consumer's direction.

Neither of the studies reviewed enters into a discussion of the economic or social consequences of the phenomena which they verify statistically. For that matter, those economic phenomena were known and discussed in books and articles by W. C. Mitchell and S. S. Kuznets, both of the National Bureau of Economic Research, and have been an economic commonplace for quite some time.

Yet, both studies *measure* the factors with which they deal and, therefore, afford not only greater insight into the workings of a competitive economic system, but quantitative knowledge sorely needed in the formulation of the theory and administration of unemployment insurance.

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Mexican Labor in the United States—Bethlehem, Pennsylvania, by Paul S. Taylor, University of California Publications in Economics, Vol. 7, No. 1. Berkeley: University of California Press. 1931. ix, 24 pp.

A delightful miniature but graphic sketch, based on extensive interviewing, of the "farthest northeast" colony of Mexicans, a few hundred strong, at Bethlehem, chiefly in the steel industry. Initiated by trainload importations from Texas in 1923, to meet a labor shortage, the colony has gradually achieved relative stability at somewhat less than half of its numbers at the peak. Members of the group participate but little in political activities and cherish the idea of a return to Mexico. They appear to suffer no marked social or economic discriminations; though, due partly to language difficulties, most of them are employed as common laborers.

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